PROCEEDINGS

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AT THE

CENTENNIAL OF CHEMISTRY

HELD

AUGUST 1, 1874,

AT

NORTHUMBERLAND, PA.

REPRINTED FROM THE AUGUST-SEPTEMBER AND DECEMBER NUMBERS

OF THE

AMERICAN CHEMIST.

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PROCEEDINGS AT THE CENTENNIAL OF CHEMISTRY.

ERRATA.

On p. 196, 2d col., 7th and 12th line from bottom, and p. 197, 1st col., 8th and 11th line from top, *for* Maurose, *read* Manross.

On p. 38, 1st col., 10th line from bottom, *for* University of Cincinnati, *read* Yale College, New Haven.

On p. 195, 2d col., line 37, *for* Retchie, *read* Ritchie.

On p. 202, 1st col., 2d line from bottom, *for* Interpretation, *read* Interpenetration.

On p. 204, 2d col., 20th line from bottom, *for* Mercury, *read* Morning.

On p. 204, 2d col., 11th line from bottom, *for* Enorgite, *read* Enargite.

On p. 195, 1st col., 10th line from bottom, *for* Natural Philosophy, *read* Physical Science.

On p. 195, 2d col., 12th line from top, *for* chemicals, *read* chimneys.

On p. 195, 2d col., 26th line from top, in place of paragraph 7, *read:* Analyses of the Atlanta Mineral Spring published and circulated throughout the State. Also, Analysis of the Mineral Springs of Meriwether County, viz.: the warm springs—carbonated chalybeate waters; and the cold spring—acidulo-carbonated chalybeate waters. Analyses of the two latter were published by Mr. George White, formerly of Savannah, Ga., in his volume entitled "Statistics of the State of Georgia."

For other errata see page 195.

THE AMERICAN CHEMIST.
VOL. V. NOS. 2, 3.

1774.—CENTENNIAL OF CHEMISTRY.—1874.

A meeting to celebrate the Centennial of Chemistry was held at Northumberland, Pa., on July 31st and Aug. 1st. It originated in the following communication from H. Carrington Bolton, Ph.D., which was published in this journal, April, 1874, p. 362.

CENTENNIAL OF CHEMISTRY, 1774–1874.

To the Editors of the American Chemist:—

Dear Sirs: The year 1774 was rendered memorable by great chemical activity. It is not possible to assign to Chemistry any definite birth-year, but so many remarkable discoveries were made in 1774 that we may, with good reason, date the foundation of modern chemical science from that period.

It would be quite foreign to the object we have in view to give here any detailed account of the state of the science at the period referred to. We may mention, however, a few of the most important discoveries which made the year 1774 noted in the annals of Chemistry.

The eminent Swedish chemist, Scheele, first isolated chlorine, calling it, in accordance with the accepted theories of the day, "dephlogisticated muriatic acid." He also recognized baryta as a peculiar earth, and it henceforth took a place among the elementary substances. Scheele also published in this same year his masterly essay on Manganese.

Lavoisier was engaged in an investigation of the cause of the increase in weight of tin when calcined in close vessels—a research which led him to subsequent discoveries of immense importance.

Wiegleb proved alkalies to be true natural constituents of plants. Cadet described an improved method of preparing sulphuric ether. Bergman showed the presence of carbonic acid in lead white. On the 27th of September in this year Comus reduced the "calces" of the six metals by means of the electric spark, before an astonished and delighted audience of savants. On the first of August, 1774, Priestley discovered oxygen, the immediate results of which were the overthrow of the time-honored phlogistic theory and the foundation of Chemistry on its present basis.

It surely requires no lengthy argument to prove that the year 1774 may well be considered as the starting-point of modern Chemistry.

Now, Messrs. Editors, I propose that some public recognition of this fact should be made this coming summer. Would it not be an agreeable event if American chemists should meet on the first day of August, 1874, at some pleasant watering-place, to discuss chemical questions, especially the wonderfully rapid progress of chemical science in the past hundred years?

Centennial celebrations are now in order. The Bostonians have renewed the memories of the Boston Tea-Party. Already the country resounds with preparations for a National Centennial in 1876. Why should not chemists meet to enjoy a social reunion in commemoration of events important alike to science and civilization? Should this proposed meeting receive your approbation, have the kindness to offer suggestions as to the proper method of bringing it before the scientific portion of the community. Details as to the place, etc., will naturally be deferred for the present.

Very truly yours,
H. CARRINGTON BOLTON.
SCHOOL OF MINES, COLUMBIA COLLEGE.

Editorial Remarks.—This suggestion meets our hearty approval, and we hope that chemists who take an interest in the suggestion will send us their views at once, that the project can be put into a practical form in time for the season of summer vacations.—EDITORS AM. CHEM.

The project was very favorably received, as is shown by letters received from several chemists: Profs. E. N. Horsford, S. Dana Hayes, Albert R. Leeds, Rachel L. Bodley, B. Silliman, T. Sterry Hunt, and others. The suggestions of Prof. Bodley determined the location of the meeting at Northumberland; they were contained in the following communication:—

WOMAN'S MEDICAL COLLEGE OF PENNSYLVANIA,
PHILADELPHIA, May 1, 1874.

Prof. C. F. CHANDLER:—

Dear Sir: I am a subscriber to your excellent journal, the AMERICAN CHEMIST, and had therefore read in its columns the "Centennial of Chemistry," which reached me this morning in the shape of a circular. Thanks for this generous recognition of a lady professor of chemistry. At the moment I was enveloping to you a copy of a recent valedictory address, in which I referred to the Centennial year of Chemistry. Now, for my suggestion as to a locality for the proposed celebration. I made a pilgrimage last August to the grave of Priestley, in Northumberland, Pa., and was deeply impressed by the locality, its associations, and its charming surroundings; my proposition is, therefore, that the centennial gathering be around this grave, and that the meetings, other than the open-air one on the cemetery hill-top, be in the quaint little church built by Priestley, where might be exhibited the apparatus devised by the great scientist, and used in his memorable experiments. I need not remind you how convenient this locality is to the routes of summer tourists, and how centrally located for those coming from the west as well as for those residing near the seashore. . . . .

Respectfully yours,
RACHEL L. BODLEY,
Professor of Chemistry.

In the Valedictory Address before the 22d Graduating Class of the Woman's Medical College, Pa., March

13, accompanying this letter, Professor Bodley uses these words:—

"*Apropos* of the pleasant hours spent together in lecture-room and laboratory, let me remind you that Chemistry holds a centennial next August beside an honored grave at the meeting of the waters of the Susquehanna, amid the picturesque scenery of interior Pennsylvania. The hand that plunged the glowing taper into the primal jar of dephlogisticated air long since crumbled into dust beneath that simple headstone, but science will not forget, through centuries to come, the historic receiver, burning lens, and taper, neither willingly let die the name of Priestley, who, in August, 1774, discovered oxygen."

At a meeting of the Chemical Section of the N. Y. Lyceum of Natural History, May 11, 1874, President J. S. Newberry, LL.D., in the chair, the subject of a chemical centennial was discussed, and, on motion of Dr. H. C. Bolton, the following resolutions were adopted:—

Whereas, the discovery of oxygen by Joseph Priestley on the 1st of August, 1774, was a momentous and significant event in the history of chemistry, being the immediate forerunner of Lavoisier's generalizations on which are based the principles of modern chemical science; and

Whereas, a public recognition of the one hundredth anniversary of this brilliant discovery is both proper and eminently desirable; and

Whereas, a social re-union of American chemists for mutual exchange of ideas and observations would promote good fellowship in the brotherhood of chemists: therefore

Resolved, That a committee of five be appointed by the chair, whose duty it shall be to correspond with the chemists of the country with a view to securing the observance of a centennial anniversary of chemistry during the year 1874.

President J. S. Newberry subsequently appointed the following committee: Dr. H. C. Bolton, Prof. C. F. Chandler, Prof. Henry Wurtz, Prof. Albert R. Leeds, Prof. Chas. A. Seeley.

By this committee the centennial was organized, and the following call was issued:—

CIRCULAR FROM THE GENERAL COMMITTEE.

To the Chemists of America:—

The year 1774 was rendered memorable by the discovery of oxygen by Joseph Priestley, by researches on chlorine by Scheele, and by important investigations undertaken by Lavoisier, which eventually led to the overthrow of the phlogistic hypothesis; the most important link in the chain having been contributed on the first of August, 1774, by Dr. Priestley.

The one hundredth anniversary of Priestley's brilliant discovery, now drawing rapidly near, is worthy of a commemorative ceremonial; and the fact, that this illustrious man spent the last years of his fruitful life in this country, renders the recognition of his work by American chemists peculiarly appropriate.

A reunion of American chemists for mutual exchange of ideas and observations would, it is believed, foster a feeling of fraternity among us, and is considered by the undersigned eminently desirable. The approaching centennial affords a fitting occasion for such a gathering. We therefore invite the chemists of America to meet at Northumberland, Pennsylvania, where Priestley lies entombed, on the 31st of July, 1874, to celebrate by appropriate exercises this memorable epoch in the history of chemistry. Signed,

George F. Barker, University of Pennsylvania, Philadelphia, Pennsylvania.
Frederick A. P. Barnard, Columbia College, New York.
James C. Booth, United States Mint, Philadelphia, Pennsylvania.
George J. Brush, Sheffield Scientific School of Yale College, New Haven, Connecticut.
George C. Caldwell, Cornell University, Ithaca, New York.
Charles F. Chandler, School of Mines, Columbia College, New York.
William H. Chandler, Lehigh University, Bethlehem, Pennsylvania.
Josiah P. Cooke, Jr., Harvard University, Cambridge, Massachusetts.
Henry H. Croft, University College, Toronto, Canada.
Silas H. Douglas, University of Michigan, Ann Arbor, Michigan.
Henry Draper, University of the City of New York.
John C. Draper, College of the City of New York.
John W. Draper, University of the City of New York
Frederick A. Genth, University of Pennsylvania, Philadelphia, Pennsylvania.
Wolcott Gibbs, Harvard University, Cambridge, Massachusetts.
Charles A. Goessmann, Massachusetts Agricultural College, Amherst, Massachusetts.
S. Dana Hayes, State Assayer, Boston, Massachusetts.
Benjamin S. Hedrick, Patent Office, Washington, D. C.
Joseph Henry, Smithsonian Institution, Washington, D. C.
Eugene W. Hilgard, University of Michigan, Ann Arbor, Michigan.
Eben N. Horsford, Cambridge, Massachusetts.
T. Sterry Hunt, Massachusetts Institute of Technology, Boston, Massachusetts.
Samuel W. Johnson, Sheffield Scientific School of Yale College, New Haven, Connecticut.
Charles A. Joy, Columbia College, New York.
H. L. Kendrick, United States Military Academy, West Point, New York.
Albert R. Leeds, Stevens Institute of Technology, Hoboken, New Jersey.
Abram Litton, St. Louis Medical College, St. Louis, Missouri.
John W. Mallet, University of Virginia, Virginia.
Henry Morton, Stevens Institute of Technology, Hoboken, New Jersey.
Henry B. Nason, Rensselaer Polytechnic Institute, Troy, New York.
John M. Ordway, Massachusetts Institute of Technology, Boston, Massachusetts.

Ira Remsen, Williams College, Williamstown, Massachusetts.

Robert E. Rogers, University of Pennsylvania, Philadelphia, Pennsylvania.

Charles A. Seeley, New York City.

Benjamin Silliman, Yale College, New Haven, Connecticut.

J. Lawrence Smith, Louisville, Kentucky.

Henry Wurtz, Hoboken, New Jersey.

Communications should be sent to

H. CARRINGTON BOLTON,
Chairman of the General Committee,
School of Mines, Columbia College, New York.

INFORMATION.

Northumberland is situated at the junction of the North and West Branches of the Susquehanna River, about sixty miles north of Harrisburg. The scenery in this regiôn, always picturesque, is at this point exceedingly beautiful, and those visiting Northumberland will be fully repaid by the beauties of Nature alone. A short distance from the town, in a hillside cemetery, charmingly located, lie the remains of Joseph Priestley; the house he built, and in which he died, is in perfect preservation; many relics of him are found in the town; here, too, dwell his descendants, who honor and revere his name. These and other considerations influenced a majority of the committee to call the meeting at Northumberland; here, then, let those gather who are willing to pay a tribute to the memory of the good and great man who laid the corner-stone of chemical science.

The memorial exercises have not been definitely arranged; but it is expected that they will include—

I. An Address by Professor Joseph Henry.
II. A Sketch of the Life and Labors of Joseph Priestley, by Professor Henry H. Croft.
III. A Review of the Century's Progress in Theoretical Chemistry, by Professor T. Sterry Hunt.
IV. A Review of the Century's Progress in Industrial Chemistry, by Professor J. Lawrence Smith.
V. An Essay on American Contributions to Chemistry, by Professor Benjamin Silliman.

Detailed programmes of the exercises will be in readiness for distribution at the meeting.

In order to add to the interest of the occasion, a Loan Exhibition will take place during the meeting for displaying apparatus, books, manuscripts, etc., belonging to Dr. Priestley, or other objects illustrating the history of chemistry. Gentlemen receiving this circular are earnestly requested to contribute anything in their possession appropriate to this Loan Exhibition.

LOCAL COMMITTEE.

Joseph Priestley, M. D., *Chairman.*
Robert B. McCay, M. D., *Secretary.*

Rev. C. G. Adams,
Joseph Bird,
J. H. Jenkins,
William G. Greenough,
Simon Randall,
G. R. Vanallen,
} *Executive Committee.*

Rev. E. E. Berry.	Frederick Burkenbine,
Rev. H. D. Catlin,	D. M. Brautigam,
John T. Colt,	J. W. Cook,
James G. Dieffenbacher,	A. E. Kapp,
William Everard,	William Elliott,
Rev. Horatio H. Hewitt,	William T. Forsyth,
Rev. James Hunter,	Alfred Hawley,
Reuben Johnson,	C. Lenker,
J. S. Mourer, M. D.,	Rev. A. D. Moore,
M. B. Priestley,	A. G. Postlethwait,
David Reimer,	Anthony C. Simpson,
Col. David Taggart,	Zachary Taylor,
M. J. D. Withington,	Cornelius G. Vanallen.

REPORT OF THE MEETING.

On Thursday, July 30, the chemists began to arrive. The following is an alphabetical list of the chemists who attended the celebration, as far as I have been able to procure their names.

C. S. Allen, New York.
B. G. Amend, New York.
H. C. Bolton, Ph.D., School of Mines, Columbia College.
P. W. Bedford, M.D., New York College of Pharmacy, New York.
J. L. Breeze, New York.
A. A. Breneman, Agricultural College of Penna., Pa.
Miss E. T. Capen, High School, Boston, Mass.
C. F. Chandler, Ph.D., School of Mines, Columbia College.
W. H. Chandler, Ph.D., Lehigh University, Bethlehem, Pa.
H. H. Croft, University College, Toronto, Canada.
J. B. Crowell, M.D., Presbyterian Hospital, N. Y.
E. T. Cox, State Geological Survey, Indianapolis, Ind.
F. W. Clarke, Ph.D., University of Cincinnati.
H. Coppee, LL.D., Lehigh University, Bethlehem, Pa.
E. B. Cox, M.E., Drifton, Pa.
J. A. Church, M.E., New York.
C. H. Chandler, Antioch College, Yellow Springs, Ohio.
T. M. Drown, Ph.D., Lafayette College, Pa.
S. H. Douglass, Ph.D., University of Michigan, Ann Arbor, Mich.
A. G. Day, New York.
W. W. Daniels, Madison, Wis.
A. H. Elliott, Baltimore, Md.
H. Endeman, Ph.D., Health Department, New York.
E. T. Fristoe, LL.D., Columbian University, Washington, D. C.
P. Frazer, Jr., Ph.D., University of Pennsylvania, Philadelphia, Pa.
J. Fretwell, Jr., London, England.
W. Falke, New York.
G. H. Fortney, A.B., Selins Grove, Pa.
Traill Green, M.D., Lafayette College, Easton, Pa.
J. Emery, Williamsport, Pa.

A. H. Gallatin, M.D., Cooper Institute, N. Y.
S. A. Goldschmidt, M.E., Savannah, Ga.
Eben Hunt, A.M., Chester, Pa.
E. N. Horsford, Cambridge, Mass.
F. Hoffman, Ph.D., New York.
T. S. Hunt, LL.D., Mass. Inst. Techn., Boston, Mass.
E. W. Hilgard, University of Michigan, Ann Arbor, Mich.
A. C. Hale, Jersey City.
B. S. Hedrick, U. S. Patent Office, Washington, D. C.
E. J. Hallock, Columbia College, New York.
W. Malvern Iles, N. Y.
C. A. Joy, Ph.D., Columbia College, N. Y.
W. K. Kedzie, State Agricultural College, Manhattan, Kansas.
R. C. Kedzie, M.D., Lansing, Mich.
R. S. Kenderdine, M.D., Philadelphia, Pa.
L. H. Laudy, School of Mines, Columbia College, N. Y.
A. R. Leeds, Ph.D., Stevens Institute of Technology, New Jersey.
W. G. Levison, Brooklyn, N. Y.
J. Macfarlane, Towanda, Pa.
Arthur Macy, New York.
J. W. Mallet, Ph.D., University of Virginia.
J. M. Maisch, College of Pharmacy, Philadelphia, Pa.
S. G. Morrison, Williamsport, Pa.
H. B. Nason, Ph.D., Rensselaer Polytechnic Institute, Troy, N. Y.
J. W. Osborne, Washington, D. C.
Rev. Dr. T. R. Pynchon, Trinity College, Hartford, Conn.
Wm. Richardson, Cooper Institute, New York.
J. P. Remington, College of Pharmacy, Philadelphia.
C. W. Roepper, Bethlehem, Pa.
Miss Ellen H. Swallow, B.S., Boston, Mass.
S. P. Sharples, S.B., Boston, Mass.
Benjamin Silliman, M.D., LL.D., Yale College, New Haven, Conn.
J. Lawrence Smith, Ph.D., Louisville, Ky.
A. P. S. Stewart, Indust. University of Illinois, Champaign, Ill.
Samuel St. John, M.D., College of Physicians and Surgeons, N. Y.
C. A. Sniffin, New York.
H. G. Torrey, U. S. Assay Office, New York City.
Milton S. Thompson, Islip, L. I.
W. H. S. Thorburn, New York.
W. H. Taylor, M.D., Richmond, Virginia.
P. H. Vander-Weyde, M.D., New York.
T. G. Wormley, Ph.D., LL.D., Columbus, Ohio.
C. G. Wheeler, University of Chicago.
A. W. Wright, University of Cincinnati.
E. Waller, E.M., School of Mines, Columbia College, New York.
T. S. Weirman, C.E., Harrisburg, Pa.
E. L. Youmans, New York.

The meeting was graced by the presence of numerous ladies, including the wives and daughters of many of the chemists present.

The following is a brief summary of the proceedings of the meetings:—

PROCEEDINGS OF THE CHEMICAL CENTENIAL AT NORTHUMBERLAND.

Secretary's Report.

A magnificent unclouded day rejoiced the chemists who had assembled at Northumberland, Pa., on the morning of the 31st of July, 1874. Promptly at 9 o'clock the large lecture room in the upper story of the fine public school building was crowded, and after a few minutes of anticipation, the meeting was temporarily organized for business by the appointment of Dr. H. Carrington Bolton, temporary chairman. On motion of Prof. E. N. Horsford, a nominating committee was appointed composed of Prof. E. N. Horsford, Dr. Albert H. Gallatin, Prof. A. P. S. Stuart, Dr. P. H. Vander-Weyde, Elwyn Waller, Prof. S. St. John.

They reported the following list of permanent officers, which was adopted by the meeting:—

PRESIDENT,

Prof. Charles F. Chandler.

VICE PRESIDENTS,

Prof. Rachel L. Bodley,	Prof. J. W. Mallet,
Prof. John W. Draper,	Prof. S. St. John,
Prof. Silas H. Douglas,	Prof. A. P. S. Stuart,
Dr. Albert H. Gallatin,	Prof. T. G. Wormley,
Prof. Eugene W. Hilgard,	Prof. Henry Wurtz,
Prof. E. N. Horsford,	Prof. C. A. Joy,

Dr. H. Carrington Bolton.

SECRETARY,

Prof. Albert R. Leeds.

TREASURER,

Prof. William H. Chandler.

FINANCE COMMITTEE.

The Treasurer, Prof. T. R. Pynchon, Prof. Traill Green, Prof. A. P. S. Stuart, Prof. H. Wurtz, Prof. Persifor Frazer, Prof. B. S. Hedrick.

COMMITTEE ON RESOLUTIONS.

Prof. B. Silliman, Prof. J. W. Mallet, Prof. J. Lawrence Smith, Prof. Wm. H. Chandler.

COMMITTEE ON SCIENTIFIC PAPERS.

Prof. C. A. Joy, Dr. T. M. Drown, Prof. F. W. Clarke.

COMMITTEE ON TELEGRAMS.

Prof. Persifor Frazer, S. P. Sharples, and Prof. C. Gilbert Wheeler.

On motion of Prof. J. Lawrence Smith, a committee consisting of Prof. J. L. Smith, Prof. E. L. Youmans, and Prof. C. A. Joy was afterwards appointed, in addition to the above, to represent America in spirit at the unveiling of the Priestley statue on August 1st, at Birmingham, England.

At the conclusion of the reading of the list of officers, Dr. Bolton called upon Dr. Joseph Priestley to conduct the president to the chair.

After a few introductory remarks the president announced Col. David Taggart of Northumberland, who delivered the address of welcome.

Address of Welcome by Col. David Taggart of Northumberland, Pennsylvania.

I have been chosen by my fellow-citizens to offer to the learned and distinguished men and women who

have gathered here to commemorate a grand discovery, and to honor a great name, a very brief but earnest welcome. We cannot follow you through the wide realms of science, nor penetrate very deeply the mysteries of nature, for we know more about oxen than oxygen, and a great deal more about the whey of milk than the Milky Way; but we can move with equal step in paying tribute of respect and reverence to the illustrious man, who eighty years ago found among "the rude forefathers" of this hamlet a quiet home, and seventy years ago an honored grave.

While in the lapse of everlasting time all human names must be forgotten, many ages will have come and gone, and left their silent footmarks on the earth, before the name of Priestley will pass from the memories and the records of his fellow-men. He has written it in letters of light and glory upon the highest, broadest pillar of the universe. By right of genius and labor he takes rank with "the dead but sceptred sovereigns who still rule our spirits from their urns."

Like the eagle, he built his eyry upon the mountain top, inaccessible to vulgar intrusions. In that pure atmosphere he dwelt, not above human spite, jealousy, and detraction—for it is easier to get below than above them—but above their annoyances. The shafts of bigots and fools were aimed at him, but they could not penetrate the triple armor which Philosophy, Enthusiasm, and Truth had thrown around him. Like you, gentlemen, he made Science his mistress, and with a pure heart and an untiring mind, he worshipped her "through long days of labor, and nights devoid of ease." And to-day he stands with Galileo, Newton, Harvey, Franklin, Faraday, and Humboldt, grand, colossal, and enduring; one of the great high priests in the boundless and beautiful temple of Nature.

A brutal English mob could burn his dwelling, and in an hour of political madness and religious frenzy destroy the work of years, but it could not stay the indomitable energy of his genius, nor dim the lustre of his brain-won renown. While the miserable wretches who composed that mob have long ago given back to the great element which he discovered 75 per cent. of their worthless carcasses, more than eighty years afterwards his great name is a talisman to draw to this quiet village many of the most renowned knowledge-gatherers of the nation—besides several from New Jersey and Canada—an aristocracy of learning and intellect that can afford to look down from its high citadels of thought and achievement with pity, if not contempt, upon the mere vulgar aristocracy of blind accident—the painted caterpillars of pretentious illiterate wealth.

As I am not vain enough to suppose that any one cares to listen to me when such illustrious names are upon the bills, I will merely reiterate to you, men and women of sense and science, in behalf of all my neighbors, a very sincere and unfeigned welcome to our homes and to our hearts. And let me assure you most earnestly, that we are not only willing but anxious to do all things possible to make you remember with pleasure your well-timed pilgrimage to the home and grave of the greatest discoverer of his time.

President Chandler replied, returning thanks, on behalf of the chemists, to the citizens of Northumberland, for their liberal hospitality.

Letters and telegrams were read from Dr. John W. Draper, Prof. Joseph Henry, Prof. Benjamin Silliman, Prof. S. Dana Hayes.

Letter from Dr. John W. Draper.

UNIVERSITY OF NEW YORK, July, 1874.

DR. H. CARRINGTON BOLTON :—

My Dear Sir: I cannot feel satisfied by merely saying that unavoidable circumstances prevent me from joining you on this occasion. No one would more sincerely do honor to the memory of Dr. Priestley, or more readily make a pilgrimage to his grave.

In my boyhood I learned to revere his name. When I was seven or eight years old, I went to school at Nantwich, a town in which he had formerly taught, and where his memory still survived. I often heard of the wrongs he had endured and of the distinction he had achieved.

Driven from his native country by public injustice, what a lesson does his example offer to us! He manfully upheld what he believed to be the truth at the risk of all that was dear to him, even at the peril of his life. But posterity, to whom he entrusted his cause, has vindicated him at last. In the summer of 1860, when the British Association met at Oxford, I witnessed the inauguration of a statue raised to his memory in the corridor of the museum of that university, Oxford of old, the focus of many of those theological views that he so strenuously combated. And now Birmingham, in which his laboratory was destroyed, his house burned, and the records of the labors of many years consumed, in that very town from which he had to flee for his life, an expiatory statue is about to be raised.

If it be given to the dead to know what is passing here, how impressive in this presence are these statements—how solemn this communion at Priestley's grave!

What an amazing change the world has witnessed since Priestley's discovery of oxygen gas—a change to no insignificant degree due to that revolution in chemistry which he inaugurated. He set sail from England on the 8th of April, 1794, and arrived in New York on the 4th of June. His voyage occupied almost exactly eight weeks. Now the steamships are making it in less than eight days.

In your circular you mention, for the information of those who desire to join you, the numerous railways by which they may reach Northumberland from all directions. This recalls to my mind a passage in Dr. Priestley's autobiography, in which, justifying his selection of that town as his residence, he very plaintively says that he hopes after some time a readier communication will be opened with Philadelphia.

How little did he foresee that vast network of railways now binding the continent together—how little the grand iron road that connects the Atlantic and Pacific! Yet these and the locomotives that run over them owe their existence to that chemistry which he did so much to develop.

Not only in the physical but also in another direction there has been a great social improvement since Dr. Priestley's time. He was refused by the Board of Longitude an astronomical appointment in Captain Cook's second expedition in 1772, on account of his religious opinions. In the numerous and costly national scientific expeditions at present on their way for observing the coming transit of Venus, probably in not a single instance has inquiry been made as to the religious opinions of the observers. Such expeditions are looked upon now, as he insisted they should have been looked upon then, "a business of philosophy, not of divinity." And yet how little can men foresee their best interests! Had the Board of Longitude been less bigoted, had they not refused him permission to go with Cook, he would have missed his greatest glory, that great discovery which you are commemorating to-day—the discovery of oxygen

gas. During his absence in the South Sea, it would have been left to Scheele, his illustrious Swedish competitor.

Once more let me express my regret that I am prevented from joining you on this occasion of commemorating what we all look upon as the most important discovery in our science, and of rendering homage to its great author.

Very respectfully yours,
JOHN W. DRAPER.

Letter from Professor Henry.

SMITHSONIAN INSTITUTION, WASHINGTON, D. C.,
30th July, 1874.

DR. H. CARRINGTON BOLTON:—

My Dear Sir: I regret very much to be obliged to inform you that I cannot be present at the very interesting ceremony which takes place to-morrow at Northumberland, on account of temporary illness induced by the late hot and changeable weather. I have, in part, prepared an address to be delivered, which, however, I think will not be missed amid the number of communications which will be presented.

I beg to assure you that it would have given me much pleasure to have been present on this interesting occasion, and to have added my tribute to the great and good man whose life and labors are simultaneously to be commemorated on both sides of the Atlantic.

I remain yours, truly,
JOSEPH HENRY.

The Committee on Telegrams reported the following telegram, which was approved and ordered to be sent to Birmingham at such time as would render it most likely to reach the chemists there assembled while in session.

Telegram to Birmingham.

"NORTHUMBERLAND, PA., July 31, 1874, 10 A. M.

"To the Priestley Memorial Committee, Birmingham, England:—

"The brother chemists at the grave, to their brothers at the home of Priestley, send greeting on the centennial anniversary of the birth of Chemistry."

"Committee on Telegrams."

A cable dispatch from Birmingham, received at Northumberland, 10.15 A. M., July 31, 1874, was read.

Telegram from Birmingham.

"To the American Chemists assembled at Northumberland, Pa.:—

"Our marble statue, representing Priestley discovering oxygen, will be unveiled to-morrow. Presented by the subscribers, through Professor Huxley, to the town, and accepted by the mayor. We greet you as colleagues engaged in honoring the memory of a great and good man.

"The Priestley Memorial Committee of Birmingham."

Prof. J. Lawrence Smith suggested, that, inasmuch as many great chemical discoveries were made in the year 1776 and about that time the discoveries of Priestley, Scheele, and Lavoisier produced their first practical effects, it would be appropriate that a world's centennial of chemists should be called in that year, especially as the American national centennial would render it easier to gather together the chemists of the world for a celebration which could not fail. The present centennial meeting would thus serve to give strength to the affair. It would be none the less appropriate to dedicate to chemistry the centennial year of America's freedom; for did not Priestley strike the first blow to enfranchise the study of the material which constitutes one universe, and to give us correct ideas of it? So it was in 1776, that this nation struck the first blow for human freedom: an event for which men in England had struggled for five or six centuries, but had failed to accomplish, but which was effectually reached by the Declaration of Independence of 1776. In conclusion, Prof. Smith submitted the following resolution, which was carried unanimously:—

Resolved, That a committee be appointed to confer with the committee of the centennial exhibition, to correspond with chemists and professors of cognate sciences in Europe, in order to induce as large a representation as possible of them to visit our country in 1876.

In pursuance of this resolution the chairman appointed to act on this committee, Professors J. L. Smith, Gibbs, Hunt, Mallet, Joy, Leeds, Bolton, Horsford, Silliman, Barnard, and Barker.

A letter from Professor Rachel L. Bodley, whose suggestion, it may be stated, determined the location of this meeting at Northumberland, was read, in which she expressed her great regret at not being able to attend the exercises here, having previously made arrangements to make a botanical excursion near Denver, in Colorado.

Prof. Henry H. Croft, of University College, Toronto, then delivered an address on the Life and Labors of Dr. Joseph Priestley. See page 43.

Professor Horsford read extracts from some original letters written by Dr. Priestley to Judge Thatcher, who was at that time a member of Congress, and whose home was at Biddeford, Maine. Judge Thatcher was the only individual with whom Dr. Priestley ventured to correspond upon subjects of a political nature. The letters were loaned to Professor Horsford by Mr. Charles Deane, Secretary of the Massachusetts Historical Society. See page 47.

Professor Leeds called attention to some interesting references to Dr. Priestley, contained in the published memoirs of the Columbian Chemical Society for the year 1813, and especially to a very beautiful poetical tribute to Priestley contained in Darwin's "Botanic Garden." The extract referred to occurs in a paper on the effect of light on vegetables and upon the physiology of leaves, by Dr. Manners of Philadelphia, in which the discovery of the evolution of oxygen from leaves when exposed to sunlight is attributed to Dr. Priestley.

The morning session was then adjourned, all the chemists present being invited by the president to assemble in front of the mansion formerly occupied by the son of Dr. Priestley, and now the residence of the hospitable Mr. Joseph Bird. The day being clear and bright, a number of photographs were successfully taken by Mr. L. H. Landy, representing the building in which the Loan Exhibition was placed, in the background, and the chemists who had been invited to deliver addresses, etc., in the front row.

The afternoon session opened with an address by Prof. T. Sterry Hunt, on "A Century's Progress in Theoretical Chemistry." See page 56.

Professor Persifor Frazer proposed the formation of a chemical society which should date its origin from this centennial celebration, and urged the importance of the fact that, while American chemists have done perhaps a larger amount of work in their own department proportionately than has been done in the world within the last century in any other branch of science, they have as yet in this country not a single society to represent the chemical thought of the country. The speaker moved that a committee of five be appointed by the president, to whom shall be referred the advisability of calling a representative committee of chemists of the United States to form a chemical society, and all questions relating to the organization of the society.

Prof. J. Lawrence Smith stated the difficulties which stand in the way of such an organization. One formidable objection was that this country was too large, and that it would be impossible to centralize its chemical research. Indeed, the very strength of the country is in decentralization. We want all our scientific institutions dispersed far and wide. We have already two great institutions in the country—the American Scientific Association and the American Academy of Sciences—which undertake to embrace in their proceedings everything connected with chemical research, and it would be more creditable to the chemical talent of this country if an attempt were made to secure its better representation in the chemical section of the former association. Even the meetings of the Chemical Society of London, where there exists a great centralization of chemists, are very meagrely attended, the members preferring to read their papers before the more distinguished Royal Society. The same is true of the French Chemical Society, while the attention of the Academy of Sciences of France is constantly asked to papers of the highest importance relating to chemistry.

The question was discussed at length by Profs. Wm. H. Chandler, F. W. Clarke, E. N. Horsford, E. T. Cox, B. Silliman, and Dr. Vander-Weyde, all of whom, with the exception of the first named, who presented forcibly many cogent arguments in favor of the formation of a national chemical society, advocated the earnest co-operation of the chemists as a body with the American Scientific Association, and that if a national chemical society were formed it should be as a permanent section of that body. At length Dr. Bolton, who, at the outset of the somewhat heated debate, had hoped that it would be possible to form a great chemical society on an enduring foundation of its own, perceived that the sense of the meeting was strongly against the advisability of such a new departure (at least at the present time, and before trying what could be done by vigorous action on the part of all the chemists in concert with the American Association), and offered the following amendment to the motion of Prof. Frazer :—

Resolved, That a committee of five be appointed from this meeting to co-operate with the American Association for the Advancement of Science at their next meeting, to the end of establishing a chemical section on a firmer basis.

The resolution was adopted. and a committee was appointed consisting of Dr. Bolton and Professors Silliman, Smith, Horsford, and Hunt.

The Committee on Telegrams submitted for the approval of the meeting the following telegram, which was ordered to be forwarded :—

Telegram to Birmingham.

Northumberland, Pa.,
July 31, 1874, 3 P. M.

"To the Priestley Memorial Committee, Birmingham, England :—

"Welcome despatch received. Professors J. Lawrence Smith, Youmans, and Joy, appointed committee to represent us in spirit at unveiling of Priestley's statue."

The afternoon session was then adjourned.

After tea the chemists, in company with a large number of visitors, were conducted to the cemetery to see the grave of Dr. Priestley, and to listen to the memorial address. The grave of Priestley lies in a pretty spot, the elevated position of which commands a view of the towns of Sunbury and Northumberland. A plain marble tombstone marks the spot where the philosopher reposes, and on it this brief and simple epitaph.

TO

THE MEMORY OF THE

REV'D DR. JOSEPH PRIESTLEY,

WHO DEPARTED THIS LIFE

ON THE 6TH OF FEBRUARY, 1804,

ANNO ÆTATIS LXXI.

Return unto thy rest, oh my soul, for the
Lord hath dealt bountifully with thee.
I will lay me down in the peace and sleep till
I awake in the morning of the resurrection.

Standing uncovered, the large audience listened to an oration by Henry Coppée, LL.D., President of Lehigh University, who at short notice had kindly undertaken to fill the place of Professor Henry, prevented by sickness from being present. See page 53.

On the conclusion of the address, in the beautiful twilight the people who were assembled quietly made their way down from the grave and hill to the lecture-room, to listen to the address by Prof. J. Lawrence Smith, of Louisville, Ky., "A Review of the Century's Progress in Industrial Chemistry." See page 61.

The Second Day's Proceedings: "Oxygen Day."

The morning session, August 1st, opened at 9 A. M., when Prof. J. L. Smith called the attention of the chemists and all others present to the claims of the Liebig Memorial Fund. He concluded his appeal with the following :—

Though chemistry has its hundredth anniversary appropriately celebrated on two continents on this day, this science has also a half-way point which claims in no small measure our appreciation. During the past one hundred years there have been not only many discoveries in chemistry, but there has been a vast development of chemists—the soul and spirit of the achievements which have already been rehearsed here. Something in the spirit in which we are in the habit of celebrating our silver and golden weddings, a movement has been commenced in Germany, which might be said to commemorate the silver epoch in the history of chemistry. That silver epoch dates back just about fifty years. It was the birth of Organic Chemistry. Although this

circumstance is due to many eminent scientists, yet one man more than all others gave it a brilliant conspicuousness and permanent development, and obtained those results which have been of the best service to us in our industrial and educational pursuits. Justus Liebig, lately deceased in Munich, it was who first made himself known to the world, just about fifty years ago, by his grand discoveries in organic chemistry. But it is not alone his wonderful achievements in this line that have made his name so dear to chemists and so familiar to the people of every land. He was pre-eminently the patron of the chemists of the past thirty or forty years, and the chemists of the present day, the agriculturists and the manufacturers, are more indebted to Liebig than to any other man who has lived since that date. His peculiar benefits to the world are recognized by all—there is hardly a child from California to Russia but knows who Justus Liebig was—but to chemists he was a great man. He first established a laboratory which was open to the world, and where all might receive instruction from himself. To his students he ever lent his encouragement and aid, and thus built up the chemists of the present day. He was a lovable man in every respect, and drew around him strong friendships. It is true he had his "notions." Some of them, as is natural of course, were erroneous, but to have made Liebig's errors would have made ten men great. He himself said at one time, "Show me a man that has made no error, and I will show you a man that has done nothing." He is dear to the chemists of America as well as of Europe, and it is proposed that we subscribe what we can each individually afford to a fund toward the monuments that are to be raised to Liebig at Munich and Giessen.

Prof. Silliman suggested, that, while chemists had not the art from their predecessors of transmuting the baser metals into gold, they could perhaps initiate a movement by which those who have profited by Liebig's work—and who has not?—might be induced to assist in these subscriptions.

Prof. Horsford said that it was the privilege of his life to have been a student under Liebig. Many of his sayings had sunk deep into his mind. His memory of what Prof. Smith quoted was a little different. Baron Liebig made the remark to Prof. Horsford, when the latter was deeply regretting some mistake that he had made. Liebig said, "The people who don't work make no mistakes." On another occasion Liebig said to him, while walking in a garden among a number of plant-pots, in which agricultural experiments were proceeding, "Make it a point to be useful to humanity." Some of his inventions have revolutionized agricultural chemistry. He was ever simplifying apparatus. He said to Brodie, a pupil, "When you start your new laboratory in London, begin with the anvil and make everything yourself; you will make mistakes, but will also make discoveries." The students of Liebig all are affiliated together with a sort of personal feeling—there is no school of chemistry—it is that they are attached by the memory of a noble life.

Subscriptions to the amount of about $650 were announced, with the understanding that they were to be devoted to the monument at Geissen only.

The applause which greeted the reading of this announcement was followed by the reading of an Essay by Prof. Benjamin Silliman, on "American Contributions to Chemistry." See page 70.

At the conclusion of Prof. Silliman's address, the following letter was read from President F. A. P. Barnard.

Columbia College, New York,
President's Room, July 29th, 1874.

Joseph Priestley, M.D. :—

Dear Sir: Having unfortunately been prevented by causes beyond my control from participating in the jubilee to be celebrated on Saturday next in commemoration of the most signal incident in the early history of modern chemistry, I cannot refrain from expressing, in the only form which remains open to me, my cordial sympathy with the impulse which has prompted this movement to do honor to the discoverer of oxygen.

Such, since the date of that ever memorable discovery, has been the progress of the world in every department of science, that we seem now almost to be living in a totally different planet.

Looking backwards upon the past, we find it scarcely possible to believe that so marvellous a history can be repeated. Yet, if we consider that for every Priestley of a century ago there are now at work hundreds at least as earnest and persevering, if not as gifted, and that of natures's countless mysteries we have as yet unveiled only the most obvious, we may easily believe, that when those who rise up to fill our places some generations hence, shall reverently assemble, as they doubtless will, to crown with honor the second centennial of this illustrious pioneer, we too shall seem to them as he seems to us now, to recede far back into the dawn of a day which we are idly flattering ourselves is already in the fulness of its mid-day brightness.

That such may be the case not only in the second, but in every succeeding centennial, will be the hope and wish of every true devotee of science, content himself to shrink into insignificance, so that the great cause of truth be advanced.

I am, very respectfully, your obedient servant,
F. A. P. Barnard.

A very interesting autograph letter of Dr. Priestley to Dr. Franklin, dated June 24, 1787, was then read by Prof. Pynchon, of Trinity College, Hartford, Conn., into whose possession the letter came by inheritance.* See page 52.

The Finance Committee reported a balance in their hands of $22.81. (This was subsequently increased to $40.81.)

Mr. Elwyn Waller moved "That the balance in the hands of the treasurer be expended for a suitable photographic album, and that all the gentlemen who had placed their names on the treasurer's list be requested to send their cartes-de-visite to Dr. H. Carrington Bolton, School of Mines, Columbia College, N. Y. Also their autographs, on a separate paper, to be inserted below their photographs. It is proposed to present this Memorial Album to Dr. Joseph Priestley and his family, to be preserved by them and their descendants until the meeting of the next Centennial of Chemistry in Northumberland, Pa., on the 1st of August, 1974." Adopted with great applause.

The chairman of the Committee on Resolutions, Prof. J. W. Mallet, presented the following report, which was adopted:—

Resolved, By the American chemists assembled at Northumberland to commemorate the discovery of oxygen gas by Joseph Priestley on the 1st of August, 1774, and his other great services to science,

That they have the greatest occasion to appreciate the remarkable kindness and hospitality which have been extended to them by the ladies and gentlemen of

* This letter has been reproduced by Mr. J. W. Osborne, by means of his photolithographic process, and he has very kindly presented copies of the beautiful fac-simile to many chemists.

Northumberland generally, under the wise arrangements of the Local Committee, who with great good judgment and efficiency have attended to every detail required to render the occasion the source of unalloyed enjoyment to their guests—and for this courteous and kind welcome they desire to return their most cordial thanks.

They have learned with much regret of the painful illness of the worthy secretary of the Local Committee, Dr. Robert B. McCay, which early deprived the committee of his valuable services, whose place has been kindly supplied by Mr. M. B. Priestley.

That they have experienced a lively satisfaction in meeting so many descendants of the illustrious man whose memory they have met to honor—a family whose present members have vied with each other in their efforts to render the visit of the American chemists to the philosophic retreat and peaceful grave of Joseph Priestley in all respects most agreeable and impressive.

That they appreciate the kindness of the amateur musical organization which has supplied such agreeable interludes to the more serious business of the sessions.

That they are also under obligations to the various railroad companies which have extended facilities to the visitors on this occasion.

That they regret the sudden indisposition of Prof. Joseph Henry, the Nestor of American science, should have deprived them of the pleasure of hearing his voice in memory of the life and character of Priestley, when assembled at his grave on the quiet and beautiful slopes overlooking the Susquehanna—an office which, however, in Prof. Henry's unexpected absence, was so admirably executed by Dr. Henry Coppée, President of Lehigh University.

And, finally, they desire to express their thanks to Dr. H. Carrington Bolton, to whose timely suggestion and considerate attention to needful details they are largely indebted for the opportunity they have enjoyed of participating in this memorial gathering, to which they will all look back with the greatest satisfaction—a satisfaction much enhanced by the sympathetic communications by the ocean cable with their fellow-workers in the common cause in the mother country.

On motion of Prof. J. L. Smith, it was now resolved that "The committee authorized to confer with the Committee of the Centennial Exhibition," etc., be authorized to increase its numbers.

The meeting then adjourned.

ALBERT R. LEEDS,
Secretary.

THE LOAN EXHIBITION.

A most extensive and interesting collection of apparatus, manuscripts, and pictures relating to Dr. Priestley, was exhibited during the meeting at the house of Mr. Joseph Bird.

Among the apparatus belonging to Dr. Priestley were retort stands, horse-shoe magnets, brass globes, astronomical apparatus, telescopes, microscopes, scales, earthen tubes, iron cylinders used for retorts, magic lanterns and many views painted on glass, compasses, small furnaces, a large Leyden jar, glass tube, bell jars, alembics, receivers, etc. etc.

There was an original autobiography in the handwriting of Dr. Priestley, engravings showing the destruction of Priestley's house and laboratory in Birmingham, and a fine oil painting of Dr. Priestley by Stewart.

A few pieces of apparatus belonging to John Dalton were loaned by Prof. H. H. Croft.

Some interesting alchemical works were exhibited by Dr. P. H. Vander-Weyde, and a series of eighty engraved portraits of alchemists and chemists was exhibited by Dr. H. Carrington Bolton.

POEM.

THE PRIESTLEY CENTENNIAL.

BY JAMES AIKEN.

[Read by the Author, at Dr. Joseph Priestley's House, on the evening of August 1st, 1872.]

Though not a scientific man,
Yet Science benefits me too;
For Science teaches those outside
Such pleasant, useful things to do!

Handmaid of Truth should Science be;
True Science such has ever been:
Warring against Humanity,
Was noble Science never seen.

The realms of matter to explore,
To ascertain its secret laws,
Through centuries hath Chemistry
Marched slowly on, without a pause.

One hundred years ago to-day,
In science was an epoch bright,
When Providence, through Priestley's toil,
Bestowed another gleam of light!

Honor to those whom God ordains
To bless the world with knowledge clear—
A Newton, Priestley, Franklin, Watt—
O, let us hold their memory dear.

We can't enumerate them all!
In every land and age have they
With honest zeal been toiling on,
To turn our darkness into day.

One name, one honored name we hail,
While standing near his burial ground—
The name of Priestley, synonym
With learning solid and profound!

Oh what an active brain had he,
And clear discriminating mind!
Through life his great desire was this:
To bless and elevate mankind.

A SKETCH OF THE LIFE AND LABORS OF JOSEPH PRIESTLEY,

BY PROFESSOR HENRY H. CROFT,
Of University College, Toronto, Canada.

Mr. Chairman, Ladies, and Gentlemen: It was with considerable reluctance that I took upon myself the duty of addressing you to-day on the subject of "Priestley, his Life and Labors," knowing full well that there were so many gentlemen, who are present, who could have performed the duty much more efficiently.

Considering, however, the very great honor conferred on me, an entire stranger, so kindly conceived and so courteously offered, I thought it would be ungracious in me to refuse.

Another reason which influenced me in accepting the position is, that biography can scarcely command or require any originality of thought or expression. Hence the duty became somewhat less onerous, for the life of Priestley is a matter of history. I come before you, then, by your kind permission, as a representative of Canadian chemists—few, I am sorry to say, but we are

only a young country. Perhaps I might claim to be a representative of a larger community—the Chemical Society of London—of which I might almost say I am one of the original members, having joined it some few months after its formation. On looking at the list of members, some three or four years ago, I found that there were only sixteen of the original members beside myself, and of these many have since left us.

The sketch of Priestley's life which I propose to read to you has been drawn up from various works, of which I will mention a few.

Dumas' "Leçons sur la Philosophie de Chemie," published in, I think, 1839; Kopps' "Geschichte der Chemie;" Thomson's "History of Chemistry;" "Lives of Celebrated Men;" Brougham's "Philosophers of the reign of George III;" Cuvier's "Éloge;" a critique on memoirs of Joseph Priestley, published in the *Edinburgh Review* of 1806, and written, as I learn from a pencil-note in our old copy, by Jeffrey, a critique just in many respects, but somewhat hard; various biographical sketches, such as I have been able to obtain access to. The original lives by, I think, his son, and by some other author [Corry], I have not been able to consult. His philosophical, or rather scientific papers, are contained in the Philosophical Transactions of the Royal Society. Of these I have numbered about forty; probably some are omitted.

Priestley's life may be said to have been twofold or manifold. He was an ardent investigator of scientific truths; he was also an "angry polemic," and a "fiery politician." So multitudinous are his works on these and many other subjects, so versatile seem his talents to have been, that, as Dumas remarks, we feel almost inclined to believe there must have been two or more Priestleys, just as some have imagined there must have been *two* bearing the name of Raymond Lullius.

Few writers have been more voluminous; but Brougham remarks—few are now less read.

I have no doubt there are many among my audience to whom much of his history is well known; but there may be some to whom it is unknown, and I will ask the indulgence of all while I describe, as briefly as I can, Priestley's life. In so doing, you must bear in mind that I am not his biographer, but simply a compiler or repeater of his biographies, and I shall confine myself to some very brief remarks on his early life, to a few of his religious and political discussions, leading to his unfortunate relations in England, and his consequent settlement in this country, and in the town in which we now meet; and then proceed to that which is of most interest to us, who now assemble here to day, the chemists of America, the consideration of his labors.

I will make my sketch as short as I can, for I consider we meet here to-day to celebrate not so much the discoverer as the discovery. None of us knew Priestley; we revere him, we honor him, for his discoveries less than for himself.

Born at Fieldhead near Leeds, in 1733, of very strict Calvinistic parents, Joseph Priestley, at a very early age, acquired strong religious tendencies; but although at first a Calvinist, he soon began to entertain ideas for himself, and got into a state of doubt, becoming somewhat of a convert to Arminianism. At this time we find him devoting himself to the study of not only the ancient languages, such as Latin and Greek, together with the modern ones, but also, in aid of his biblical researches, of Hebrew, Arabic, Chaldee, and Syriac. His power of acquiring languages, and his memory generally, seem to have been enormous, and rendered him in future years a most formidable antagonist in all those polemical discussions in which he was so prone to engage.

His religious opinions were what at that time was considered peculiar and heterodox; and, on attempting to enter the ministry, he was rejected on account of his views with regard to original sin, the atonement, and eternal damnation, views which, resulting from his own fervent convictions, he maintained openly and fearlessly, and subsequently, although acting as preacher at Needham, he failed to become popular, partly on account of an impediment in his speech, but more from his known tendency to Arianism and to Socinianism. To the latter sect, better known under the name of Unitarians, he finally belonged. Brougham sarcastically remarks that the people of Needham probably thought their privilege of eternal hell-torments to be rudely invaded by their preacher.

His disbelief also in the Trinity being notorious, he very soon—at the early age of twenty-five—got into disagreeable relations with many parties, and had to leave Needham. At Nantwich he succeeded better, established a school, and commenced his scientific studies, for which, however, he had had very little preliminary preparation. These he continued afterwards at Warrington, whither he removed in 1761.

An acquaintance with Benjamin Franklin led him to turn his attention to electricity, and within the year he produced his "History of Electricity," a work which, although thought much of at the time as a useful compilation, does not seem to have added greatly to his reputation; the same may be said, to a greater extent, with regard to his "History of Vision," both works being too rapidly and carelessly written, a common fault with all Priestley's writings. He made a number of experiments on electricity, which, although not adding much to the science, rendered his name so well known, that he was elected member of the Royal Society. According to another biographer, he had been a member a year before. It was much easier to become an F.R.S. then than now; but we must remember that Priestley's most brilliant discoveries, which gained him the gold medal and recognition from crowned heads, came afterwards.

About this time there was a chance of his being appointed chaplain on Captain Cook's second voyage, but here his unfortunate religious opinions came in his way, and he was rejected by the admiralty on account of his heterodoxy, which, however, it has been remarked by one of his biographers, did not seem likely to have in-

terfered materially with his observation of stars, plants, and natural phenomena generally.

While at Warrington, 1761–1769, his pen was most prolific, and among his writings may be mentioned, "A Theory of Languages," books on "Oratory and Criticism," on "History and General Policy," on the "Constitution and Laws of England," on "Education," a "Chart of Biography," a "Chart of History."

In 1767 he removed to Leeds, and became minister of the Mill-hill Chapel, and wrote many controversial books and pamphlets. In after times he wrote "Letters to a Philosophical Institution," "An Answer to Gibbon," "Disquisitions on Matter and Spirit," "Corruptions of Christianity," "Early Opinions on Christ," "Familiar Letters to the Inhabitants of Birmingham," "Two Different Histories of the Christian Church," "On Education," "Comparison of Heathen and Christian Philosophy," "Doctrine of Necessity," "On the Roman Catholic Claims," "On the French Revolution," "On the American War," besides twenty volumes of tracts in favor of Dissenters and their rights. (Brougham.)

In 1773 he entered the service of Lord Shelburne, afterwards Marquis of Lansdowne, as chaplain, and remained with him for seven years, leaving with a pension of £150 per annum, and no ill feeling on either side, but probably from the openness with which he expressed, and the pertinacity with which he maintained, his own opinions on religious, political, and indeed all other matters. In Lord Shelburne's company he visited Paris, and various parts of the Continent, and at Paris was present at a discussion between two chemists as to the nature of red precipitate, what we now call mercuric oxide. It is not improbable that what he heard that day led to his future experiments, and hence to this meeting.

Leaving Lord Shelburne, in 1780, he settled in Birmingham, and continued his scientific and theological studies and writings for several years. Unfortunately he entered into a violent controversy with members of the Established Church, and, as he had no hesitation in expressing his views very freely, and did not confine himself to polemical discussion with the above named sect, but equally Calvinists and Arminians, Arians, Presbyterians, Methodists, Roman Catholics, and Swedenborgians, it is not to be wondered at that he got into some disrepute. It was not sufficient for any one to agree with him partly, he must agree entirely; a deviation of a thousandth of an inch either one way or the other constituted an antagonism. Indeed, it is doubtful whether any one ever entertained Dr. Priestley's belief except Dr. Priestley himself. (Brougham.)

Whatever amount of toleration in religious matters there may be in England now, there was much less a century ago. The Established Church looked upon all Dissenters with suspicion and dislike; and the government of the day, fearing the introduction of reform and liberal opinions, emanating generally from the dissenting portion of the community, took much the same view.

So powerful a writer on religion and politics was an eyesore to a Tory government. Burke's paper on the French Revolution had been answered by Priestley in such a manner as to arouse the indignation of that statesman, and to cause him to attack Priestley with great virulence, even in the House of Commons.

The French Revolution itself had also much to do with the ill feeling which arose in England against Priestley. His open expression of admiration for the new republic, conjoined with his very free writing on religious subjects, led many Frenchmen to believe, very erroneously, that he entertained similar views to those held by themselves. When in Paris, he was told by certain savans that he was the only sensible man they had ever met who believed in Christianity. Hence, while laughed at in France for being a Christian, he was decried in his own country as being what some persons called an atheist.

The latter is entirely untrue, for there was probably never a more truly moral and religious man than Joseph Priestley. Thomson says: "He admitted the whole of the sublime morality and the divine origin of the Christian religion, which may charitably be deemed sufficient to constitute a true Christian."

To this remark I confess I most cordially concur; but ideas in England, in 1780, were not so liberal. Priestley had rendered himself obnoxious to the Church by his so-called heterodox ideas on religious matters; to the government by his bold advocacy of liberal opinions; to the people of England generally by his openly expressed admiration of the French Republic. The popular feeling was at that time very strong against France; and the fact of a minister of religion expressing his admiration of a system which only three weeks before had been instrumental in causing those atrocious butcheries which disgraced the French Republic, naturally created a feeling against Priestley, for which, however, he was not in the least accountable, any more than the British nation was guilty of the unwarrantable treatment to which he was shortly submitted at the hands of a mob and some prejudiced parties.

On a celebration of the storming of the Bastile, held in Birmingham, at which, however, Priestley was not present, popular feeling rose to such a height that the church and house of Priestley, and those of many of his friends, were destroyed by the mob. We know what an unreasoning thing a mob is. You in the United States are not entirely unacquainted with it. On a recent visit to England I went to Nottingham and saw the castle, one of the most magnificent edifices of England, in ruins, from some absurd popular outbreak, I believe of the Chartists.

I have seen the Parliament Buildings and excellent Library of Canada burnt down by a mob, because a bill had been passed which did not meet the views of a minority.

Priestley, not sure of his life in Birmingham, went to

London, and here he found the feeling still strongly against him, a feeling for which I shall not attempt to apologize, as it is something which at this time we can scarcely conceive.

He had the greatest difficulty in obtaining a lodging, the landlord being afraid of his house being burnt down. He was shunned by the members of the Royal Society. His life was embittered, and he left England for a land where he was sure his religious and political opinions might be freely promulgated, without interference and without complaint. He was somewhat wrong; the same odium, which attached to him in the old country, accompanied him here to a slighter extent. Clergymen of any other sect looked on him as a heathen, though, when they came to know him, they acknowledged their transgressions. I have no time to introduce illustrations of this, which I might do. His political principles found no favor with the Adams administration, and I am told he was threatened with expulsion from the country. Under Jefferson's reign Priestley was at peace, and ended his days, after a continued writing on religious and scientific subjects, here, where we are assembled to-day.

I believe he was failing for two years before his death, and place no credence on the story told by Dumas, that he was accidentally poisoned by some article eaten by the whole of his family, but which had a fatal effect only on him. I find no notice of this in any other writer.

It is scarcely in my province to speak of Joseph Priestley's character as a moral man; but in all that I have read, I find him described as a strictly honest, upright, moral, and religious man, with faults—who has them not? Although a most furious polemic, those who were opposed to him, when personally acquainted, became his friends; his religious opinions, opposed as they were to those of many with whom he was thrown in contact, often produced ill-feeling which gave way to his own personal amenities.

Let us now turn from Priestley's life to Priestley's labors. Here we find the theological, political, and literary, entirely overpower the chemical, occupying, I believe, about fifty or sixty volumes. With these we need not occupy ourselves (I have given a few instances already), but confine our attention to his labors on that science which is specially represented here to-day.

The discoveries which Priestley made in chemistry would have established the fame of half a dozen ordinary workers, and yet it cannot be said that he possessed any very profound knowledge of the science as it then existed; indeed, in many parts he was very deficient.

He himself modestly ascribes most of his discoveries to accident, herein perhaps not doing himself the justice he deserved; accident has doubtless much to do with chemical discoveries, more perhaps in former times than now, when researches are usually undertaken with some definite end in view; but how many of the discoveries which have led to the most brilliant and important results, may not be called accidental? I question if Davy expected to find potassium when acting on potassa with a voltaic battery, although, having already observed the decomposition of other metallic oxides, he may have had an inkling of the fact. Bunsen did not expect to find two new metals when examining the residue from the Durckheim waters. Crookes, when looking for selenium, accidentally found thallium. Perkins, when he found that aniline, when acted on by chromic acid, gave a fine color, could scarcely have expected the enormous manufacture of these or analogous dyes, which is carried on at the present day.

However much Priestley may have been assisted by accident, we are none the less indebted to him for them, and for the consequent enormous impetus given to our science.

The first chemical investigations of importance made by Priestley seem to have been at Warrington, where, residing in the neighborhood of a brewery, he had ample opportunities of experimenting on *carbon dioxide*, *carbonic acid*, or *fixed air*, as it was then called. This gas was already known, and Black, while experimenting on it, had, to a certain extent, laid the foundation of pneumatic chemistry; but Priestley carried the matter out so much further and with such ingenuity as to entitle him to be called, as he has been, the father of that branch of the science.

His apparatus was all made by himself, or by unskilled workmen under his direction, and much of it we use at the present day in our lecture-rooms. He first introduced mercury for collecting gases soluble in and therefore not to be collected over water; and it seems probable that he obtained chlorine, but failed to recognize it, perhaps from its action on mercury.

The fact of carbon dioxide being soluble in water, and also to a greater extent under increased pressure, was known to Priestley; hence our so-called soda water manufactory.

Hales had made some experiments on the production of nitric oxide, but Priestley carefully examined and described its properties. He found in it a reliable means of detecting the presence of vital air, "dephlogisticated air," or oxygen, as we now call it. He was in the habit of using small animals, such as mice, for proving the presence or absence of the vital air, and found in the nitric oxide a chemical test not requiring the sacrifice of animal life. In one of his experiments, he left the mouse for some months in the jar, and on examining it, found the carcass perfectly fresh and sound. This fact seems to have been overlooked. The preservation of meat by means of nitric oxide has been recently introduced, one hundred years after Priestley's observation.

Another discovery of his was that of nitrous oxide, produced I believe by the action of iron on nitric oxide; the properties of this gas were examined, but I am not aware that he was acquainted with its physiological effect; that was left for Davy. And here I may mention a fact that I learnt only a few days since, viz., that Davy proposed or hinted at the possibility of employing nitrous oxide in surgical operations. (See Silliman's address in 1871.)

In the course of his investigations upon gases, he found that, however different in density, they commingle and remain so for any length of time, a subject further investigated by Dalton. He also found that gases would mix when separated by bladder, which may be said to have been the foundation of osmose and of the brilliant discoveries of Graham and others. This observation was made in Northumberland, but seems to have been overlooked.

The reduction of metallic oxides by combustible air or hydrogen was known to him, although, on account of his adherence to the phlogistic theory, his explanation was not correct. I may add that the last scientific paper he wrote in 1802 was in defence of this theory. He found that vital air or oxygen turned dark venous blood red, and that plants inhale oxygen in sunlight. In Northumberland he also discovered carbonic oxide, but for the same reason as mentioned above did not understand its nature.

Fluoride of silicon, sulphurous acid, hydrochloric acid, were all discovered by Joseph Priestley. Ammonia was another of his discoveries, and he found that when treated with electric discharges it increased its bulk, but he failed to show its composition. It has been said that he was the first to employ electricity in this way, but it seems that Volta had done so before him. He also seems to have been the first to notice the formation of water when electric sparks are passed through a mixture of air and hydrogen, a fact afterwards examined by Cavendish, and on which an hypothesis was founded by Watt.

I know there are many discoveries of his which I have omitted, but they were not of the striking character of those I have mentioned, and enough has been said to show how successful he was as an experimenter. Of the most important gases known at present, we owe nearly three-fourths to Priestley. I shall not dilate on the importance of his principal discovery, viz., that of oxygen, that more properly belongs to the address which you will hear from Prof. Hunt.

In conclusion, let me draw your attention to the articles shown in the loan exhibition, which are specially interesting to us as having been perhaps some by which his discoveries were made; to supplement them to a certain extent, I have brought with me a few articles which were used by Dalton, a man as famous as he whom the chemists of America have met here to-day to honor.

PRIESTLEY'S LETTERS.

PRESENTED BY E. N. HORSFORD.

At the conclusion of Prof. Croft's address, the president invited the presentation of personal reminiscences of Dr. Priestley. Prof. Horsford stated that there had been placed in his hands by Charles Deane, Secretary of the Massachusetts Historical Society, to be read if occasion should call for them, a series of letters written by Dr. Priestley between 1788 and 1800 inclusive, to Hon. George Thacher, member of Congress from the district of Maine. The accompanying note* from Mr. Deane, who kindly acquiesced of the wish of the officers of the Centennial Congress, that the letters might be published as a part of the proceedings of the celebration, will sufficiently indicate the character of the gentleman who enjoyed the confidence of Dr. Priestley at this period of his life.

The letters, with here and there an omission, which the limited time seemed to make necessary, were read. They are now presented complete, *verbatim et literatim*, and will be found to shed most grateful light upon the character and life of the great and good man.

NORTHUMBERLAND, Dec. 28, 1798.

DEAR SIR:—

I am glad to find that you are returned to Philadelphia, and that you are not afraid to correspond with so dangerous a politician as I am; and as I have no correspondence with any other member of Congress, I shall perhaps be troublesome to you.

I have employed myself this summer very much in my laboratory, and have sent several articles of a chemical nature to the *Medical Repository*, printed at New York. Four of these, I hear, will be published in their two next numbers, and I have one more to send. The object of them all is to show the fallacy (as it appears to me) of the French theory. But I want to hear from the French chemists themselves, and when we shall have any intercourse with that abominable country you Federalists can tell better than I can. I suffer much in various ways for want of it. Who are the gainers I cannot tell.

I shall very soon print my *Comparison of the Institutions of Moses with those of the Hindoos*, etc., in this place, at my own expense, and shall be obliged to my friends if they will take as many copies as they can dispose of, that my loss may be the less. But I shall not again propose to print any Works by *subscription* in this country.

My son, who expects to be in Philadelphia in about a Week, will endeavour to make some agreement with Mr. Gales about the printing of my *Church History*, if he will take *lucre* which I have, instead of *mines* which I have not. If this can be done, I shall be much obliged to you for transmitting the proofs, etc. But

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* CAMBRIDGE, MASS., 10 August, 1874.

MY DEAR MR. HORSFORD:—

I am glad to learn from you that the letters of Dr. Priestley which I intrusted to your care to be exhibited at the recent Centennial Celebration at Northumberland excited considerable interest; and you add that a wish has been expressed that copies may be taken for publication. In complying with this request, I desire to say a single word concerning the distinguished gentleman to whom the letters were addressed—the Hon. George Thacher. He was at this period a member of Congress from the District of Maine He resided at Biddeford He had been a delegate to the Old Congress, and a Judge of the District Court of the United States. In 1801, having accepted the appointment of Judge of the Supreme Judicial Court of Massachusetts, which position he held till 1824, he resigned his seat in Congress. He died on the 6th of April in the year last named. Judge Thacher was a man of the highest character for probity and intelligence. He was a great reader, was particularly versed in polemical and theological controversy, and was celebrated for his wit. He was a stanch Federalist in politics, but was attracted to Dr. Priestley by his advanced religious opinions and by his metaphysical writings, and no doubt by admiration of his character. It is said also that Judge Thacher s scientific attainments were respectable.

These letters were intrusted to me some years ago, with the understanding that I should ultimately place them in some public depository. Before doing this I had designed to suitably annotate them and print them, having myself always had a great admiration of Dr. Priestley; but I have never found time to do this, and I am now happy to submit them to you for publication in the manner you have suggested. I will then make such disposition of the originals as was intended.

Faithfully your friend,
CHARLES DEANE.

what can I do when you are not in Philadelphia, as the expense of postage will be very great?

When I wrote last, I think I had finished my Exposition of *Daniel* and the *Minor Prophets*. I have since that completed, and transmitted my Exposition of *Isaiah*, *Jeremiah*, and *Ezekiel*, and reverting to Genesis, have about half finished the Pentateuch. In the course of the next summer I hope to finish the whole. This will be a large work, and whether it will ever be published is very uncertain. But if not, I cannot employ my leisure hour more to my satisfaction; except, you may say, in disturbing peaceable kingdoms and States. But of my political publications I must not say anything to *you*.

Yours sincerely,
J. Priestley.

P. S.—I wish you would send me the American edition, I see advertised in Brown's Newspaper, of the *Intercepted Letters* addressed to me; and any political intelligence you dare to trust me with.

Northumberland, Jan. 7, 1799.

Dear Sir :—

As you do not complain of the liberty I have taken, I shall trouble you pretty often in the same way. As my son has probably sailed before this time, I wish you would tell Mr. Gales that he agreed with Mr. Kennedy, the printer in this town, about the printing of my "Comparison of the Institutions of Moses," etc., and undertook to buy a quantity of type for the work, and that I have seen the paper maker; so that if, as he writes to Mr. Degrachy, he has made any agreement with Mr. Gales about the printing of the same work, he must have forgot what was done here, and that I think myself bound by. If he has agreed with him about the printing of the Church History, it is very well, and part of the copy shall be sent to Mr. Gales whenever he chooses.

You say you wish I were as zealous a friend of America as Mr. Hone is of France. Both Mr. Hone and myself, as well as Dr. Price and many others, were as zealous in the cause of America as he now is in that of France. If I had not been so, I should not have come hither, nor am I changed at all. I like the country and the Constitution of your Government as much as ever. The change, dear sir, is in you. It is clear to me that you have violated your Constitution in several essential articles, and act upon maxims by which you may defeat the whole object of it. Mr. Adams openly disapproves the most fundamental article of it, viz., the election of the Executive. But as you say, we cannot see our own prejudices, and cherish them as truths.

I may be doing wrong in writing so freely, and I have been desired to be cautious with respect to what I write to you. But I am not used to secresy and caution, and I cannot adopt a new system of conduct now. There is no person in this country to whom I write on the subject of politics besides yourself, nor do I recollect what I have written; but I do not care who sees what I write or knows what I think on any subject. You may if you please show all my letters to Mr. Adams himself. I like his address on the opening of the Congress, and I much approve of his conduct in several respects. I like him better than your late President. He is more undisguised. We easily know what he thinks and what he would do, but I think his answers to several of the addresses are mere intemperate railing unworthy of a statesman.

My general maxims of policy are, I believe, peculiar to myself. When I mentioned them to Mr. Adams he was pleased to say that "if any nation could govern itself by them it would command the world." Of this I am fully persuaded; but he has departed very far from them. All that I can expect is the fate of the poet Lee, who, when he was confined in a mad-house, and was asked by some stranger why he was sent thither, replied, "I said the world was mad and the world said I was mad, and they outvoted me." My plan would prevent all war and almost all taxes. But if the calamities of war, heavy taxation, the pestilence, etc., or any other evil, be required for the discipline of nations, as I believe that in the present state of things they are, they will be introduced from some cause or other. This country as well as others wants a scourge, and you are preparing one for yourselves.

With every good wish to you and your country, I am, dear sir (though an alien),

Yours sincerely,
J. Priestley.

Northumberland, Jan. 10, 1799.

Dear Sir :—

I sent you by Mr. Ecroya, *Mr. Belcham's answer to Mr. Wilberforce*, and by Mr. Humphreys, *Mr. Hone's pamphlet.* They may both be had by inquiring of Mr. Vaughan.

I hope I do not take too great a liberty in inclosing *two open letters*, for your conveyance according to their directions. I know they must not be *sealed.* I wish to write in the same manner to a friend or two at a great distance, and whom I wish not to burden with the expense of postage, but I shall not proceed any further without your permission.

I am, Dear Sir,
Yours sincerely,
J. Priestley.

P. S.—My daughter may bring back the pamphlets, but you may keep them as long as you please.

Dear [Sir] :—

I fear I take too great liberties with you: but I wish to convey the inclosed to my son, and hope you will excuse it.

I am sending to the press my *Comparison of the Institutions of Moses with those of the Hindoos*, etc.; but shall not be able to print my *Church History* at present. Had not Mr. Vaughan been so unfortunate, I could have done pretty well. But though I have landed security for the money I had in his hands, which is all that I have in this country, these lands are uncultivated, cannot be sold for anything at present, and yield no revenue. I go on, however, to write in hope of better times, but I shall no more propose a *subscription* to anything.

I send by this post an article for the Medical Repository, at New York, and once thought of troubling you with it; but on second thoughts have not. I have desired, however, Dr. Mitchell, my correspondent there, to send me some printed copies of what they print of mine to you to be conveyed under your cover.

I am, Dear Sir,
Yours sincerely,
J. Priestley.

Northumberland, Jan. 17, 1799.

P. S.—Say nothing to anybody, of what I wrote about Mr. V. &c.

NORTHUMBERLAND, Feb. 14, 1799.

DEAR SIR :—

If I had not had the most perfect confidence in your friendship I should not have written to you as I have done on the subject of *Politicks*, knowing how very different your sentiments in that respect are from mine. I have no other correspondent to whom I mention the subject at all, and seldom think of it but at the moment of writing. My thoughts you may easily perceive are engaged other ways.

I am glad that you like Mr. Belsham's pamphlet so well. You may keep it, as I can get another easily. I should have added the article you wish for to the *History* of *Corruptions*, but I had little or nothing to say *historically* on the subject. I shall, however, attend to it, and endeavor to make a section to your mind.

I am quite ready to begin the printing of my *Comparison*, but fear we shall be delayed by the want of *type*. If you can do anything to forward it, I shall be much obliged to you. Be assured I shall never lose sight of the *exposition and corrected version of all the books of Scripture*, and the kind of illustration that you mention will be very particularly attented to. Hitherto I have united nothing of the kind that has come to my knowledge.

I have just received a letter from Mr. Lindsay, who mentions some *philosophical articles* that have been sent to me in *the Neptune*, Capt. *Joseph Saunders*. From the manner in which he speaks of this package, I conclude that I ought to have received it some time ago, whereas I have heard nothing of it, or of any advice concerning it, to Mr. Vaughan or myself. I shall be much obliged to you, indeed, if you will be so good as to make the necessary inquiry concerning it, and if it can be found, see it lodged safe till I can send for it. Mr. Lindsay also mentions a *parcell* of *books* that he has sent me; but he does not say by what ship, and another *smaller parcell* that was sent with this letter, but does not mention the ship. This, however, must be one that arrived very lately.

I suffer much by these delays and loss of parcells. If they lie at any public office, I fear they will be opened, and then it will be impossible for anybody to replace the articles without certain injury. Hitherto by Mr. Vaughan's interest I have been favored, the packages being sent hither, and I then informing them of the contents. I hope by your means to have the same favor continued. It is, indeed, of great consequence to me. All my books and instruments must come from England, which alone is a great disadvantage that I must labour under [in] this country independently of other circumstances. Mr. J. Vaughan is at No. 63 Duke Street, but perhaps does not make his appearance.

I shall print my *Comparison* at all events, and be thankful for any assistance my friends can give me by way of lessening the certain expenses attending it. Whether I shall be able to print anything more in this country is uncertain. I shall certainly go to the utmost extent of my own funds. My *Philosophical articles* will be printed in the *Medical Repository*, and cost me nothing. I am very busy in that way, but this does not interest you. I often wish this place lay in the way from Biddeford. It would give me great pleasure to show you my conveniences, which are beyond everything I ever had before.

Yours,

J. PRIESTLEY.

DEAR SIR :—

Looking into my *Institutes*, I find I have said all that I know, and I believe all that is known about the *devil*, etc., in the way of *argument*. I should now only say that I believe, with Mr. Palmer (now in Botany Bay), that the *fallen angels* of Peter and Jude were the *descendants of Seth*, who perished in the deluge. See the *Theological Repository*, vol. 5, p. 166. As to an *historical* article, I could not find material for one. I often wish you were nearer to me, that I might get your perusal of what I am composing for the press. Here I am absolutely isolated. When the Congress shall remove to the federal city, perhaps you may sometimes include this place in your way, and spend a week or more with me. Otherwise I shall hardly see you any more. [word wanting] your affection for England, I wish you would learn their exactness in the conduct of the *post-office*. The last post brought us newspapers, but the *letter bag* was left behind. I expected a letter from Mr. Russel and perhaps from you.

I wish you could get me the full *titles* and *dates* of the impression of Dr. [name cannot be made out] 's *History* of *Indostan*, and *Holwell's Interesting Historical* Events. I had them from the Circulating Library in Philadelphia, and returned them without noticing those circumstances, and I wish to describe them more circumstantially in my preface, than I have done in my reference to them. I am.

Dear Sir,

Yours sincerely,

J. PRIESTLEY.

NORTHUMBERLAND, March 1, 1799.

NORTHUMBERLAND, Dec. 12, 1799.

DEAR SIR :—

Your letter was peculiarly welcome, for in truth, I was afraid you would have revolted at my *politics;* as you are so violent a federalist, and I such a democrat. Since, however, you could bear the *first* part of my letters, I will venture to send you the *second* by this post, and then you will know the worst of me.

The Porcupine's abuse had no effect on you, it had on many others; and even in this part of the country I was generally regarded as a dangerous person. For in this country it is not one person in a hundred that know any thing of my writings or my history. I was frequently called an *atheist*. Porcupine's paper was taken by all the most reputable federalists in these parts, and many I believe propagated suspicions of me that they did not entertain themselves.

Before I received your letter I had sent Mr. Dobson a copy of my *Comparison*, with directions that after he had looked into it (in order to judge whether it would be worth his while to take the impression upon himself or not), to deliver it to *you*, and I beg your acceptance of it. I have since heard that he declines having anything to do with it, except selling it on my account. This I wish to avoid, and another bookseller seems inclined to take it. I desire nothing for my trouble, but I wish to be *indemnified*, and to have as little as possible to do with the *sale*, as it is a thing that I should manage very ill. I should have preferred Mr. Dobson to any other bookseller, and I wish you would ask him to show you the letters I wrote to him on the subject. But do not solicit him to take it as a *favor* done to me. I do not like such obligations, and a bookseller I well know may get money when the author would be a great loser by the sale.

Mr. *Cooper's pamphlet* was sent, together with the copies of mine, to Mr. Campbell, bookseller, in Market street, by a wagon which left this town yesterday, so that you may soon see them.

I have now completed my *Notes on all the books of Scripture*, without omitting even *Solomon's Song*, which at first I did not intend to meddle with, as there is nothing of religion in it. My *Church History* was finished long before; but these I believe must remain to be disposed of by my executor.

I have completed my experiments in defence of the doctrine of *phlogiston;* and having now heard all that has been, and I believe *can* be advanced against it, I begin the next week to print my *Defensive Treatise* on the subject; and I pretend to nothing less than a *demonstration* of the fallacy of the opposite new theory, though supported by almost [all] the chemists in Europe, and this country too.

If you dare trust me with any political information, I shall be glad to receive it.

Yours, sincerely,

J. PRIESTLEY.

NORTHUMBERLAND, Jan'y 9, 1800.

DEAR SIR:—

Having heard nothing from Mr. Dobson, and he having twice refused to have anything to do with my *Comparison*, I authorized a friend to dispose of it to Mr. Campbell, with whom the copies now are. He reimburses me all my expenses about it; but without the exertions of my friends, I fear he will be a loser by it, not indeed finally (for if any theological work of mine be readable, I think this will), but in these times it will go off very heavily, and he may be discouraged. I shall therefore be much obliged to you and to my friends in general, if you will recommend it where you have opportunity, and I hope that Mr. Dobson will promote the sales as much as he can, tho' he did not chuse to take the expense of it upon himself.

Mr. Campbell takes my *Letters* as well as the Comparison. With respect to *this* I only ask your forbearance, and if you think I have offended, your forgiveness. Consider, however, how long I bore every species of abuse without any reply. What I suffered with respect to *character* in this neighborhood you cannot know. But in consequence of perpetual and uncontradicted accusation, I was generally considered as a dangerous person. In this respect I find that these Letters have been of great use, and I have reason to think that, in consequence of the candid account of my principles and conduct, I shall have no occasion to trouble the public with anything farther on the subject, tho' I find there are many Porcupines in this country, and with them my case is not at all mended.

I have lately received some valuable theological publications from England, which I wish you could see; but I have no opportunity of sending them, and several of them are now bound up with other pamphlets. They do not, however, contain any sentiments that would be *new* to you. But they are well written, and excellently adapted to *existing circumstances*, as the phrase now is.

I often wish I could see you in my *shed* as it is called. But it is too much out of your way in going or returning from Congress; and besides we have not yet any stage coach to this place.

With every good wish, I am,

Dear sir, yours sincerely,

J. PRIESTLEY.

DEAR SIR:—

I truly admire the candor you express with regard to my *Letters*. It is more than I expected even from you, and I must say that with the Federalists in general, it is very uncommon. At least so I have found it in my own case. I am pretty well known to have been (at some risk to myself) a zealous friend to your revolution when I was in England. When here I never meddled with your politics for five years, and yet no person in the country has been exposed to such outrageous abuse. As to the Federalists at a distance, I stand as I expected, just as I did before. The virulence of Porcupine is taken up by other writers, but I have mended myself a little here, and with that I am satisfied; and I hope I shall have no occasion to give you, or them, any further trouble in this way. It was with great reluctance that I did what I have done.

I shall thank you if you will tell me what you wished me to have omitted in the Letters, or anything in which you think I am *palpably* wrong. I do not mean to draw you into any controversy, but I will *think* of it.

Mr. Dobson has not acted like a friend with respect to the *Comparison*, and of my *Letters* which I did not mention to him, he says "*my friends are ashamed for me.*" I wish he would shew you my last letter to him that you may judge whether he had any occasion to write to me in that manner. I made him the offer of the Comparison three different times, desiring nothing but indemnification.

The *Layman's Answer to Wilberforce* is one of the pamphlets I wished to put into your hands.

I thank you for your good wishes with respect to my *Notes on the Scriptures*. They are ready, but when they will be *called for* does not depend upon *me*. I have just printed, except the Preface, a philosophical work, which I entitle *The doctrine of phlogiston established and that of the composition of water refuted*.

You will wonder at my confidence when almost all the world is against me. But I have cautiously examined the ground, and think I stand very firm. I do not think the allied powers have now the same confidence in their contest with France.

I trouble you with the enclosed for Mr. Campbell, and am

Dear Sir, yours sincerely,

J. PRIESTLEY.

NORTHUMBERLAND, Jan. 23, 1800.

NORTHUMBERLAND, Feb. 20, 1800.

DEAR SIR:—

I trouble you with *two letters*, which I shall be much obliged to you to forward according to the directions. That to Mr. Baynham is somewhere *near Lake Champlain*, but probably you will be able to direct it better than I can.

I lately sent to Mr. Smith by Mr. Campbell, some copies of a *chemical tract* in defence of the doctrine of phlogiston. Tho' you are not a chemist, you may perhaps find something to amuse, and I hope please, you in the Preface, &c.

I am now writing a *Dissertation on the knowledge of a future state among the ancient Hebrews*. I have been used to think there were no traces of it in the Old Testament, but I now think they furnish me a demonstration of it. I wish I could submit it to your inspection. I shall transcribe it in a few days, and, if I have a good opportunity, will send it to you.

I shall be much obliged to you, and Mr. Vaughan, to

take two copies of my *Comparison* of Mr. Campbell and take the first opportunity of sending them as presents from me to Mr. Freeman of Boston, and Mr. Bentley of Salem.

With every good wish, I am,
Dear Sir, yours sincerely,
J. PRIESTLEY.

P. S.—I thank you for the enclosure by the last post.

NORTH'D, March 6, 1800.

DEAR SIR :—

I thank you for the *Magazine* you sent me. It contains many valuable articles. I am also much obliged to you for *Mr. Webster's Letters.* I have no thoughts at present of writing anything more in that way, but I may be led to think and act otherwise.

I am sending my *Dissertation on the knowledge of a future state among the Antient Hebrews* to England. Mr. Lindsey will probably get it printed in some form or other.

I am engaged in a promising train of *experiments*, and everything in this way is much more expensive here than in England. But I cannot be idle. You see that rather than do nothing, I even write on politicks, of which you Federalist, will say I know nothing at all.

With every good wish I am,
Dear Sir,
[Signature cut out.]

P. S.—I take the liberty to trouble you with the inclosed.

NORTHUMBERLAND, March 20, 1800.

DEAR SIR :—

I thank you for the *Tract on Prophecy*. Everything on that subject interests me much. I wish I could see the *other tract* that Mr. Winthrop mentions. Perhaps you can send it me from Boston.

I enclose a letter for *Noah Webster* and wish you would complete the direction, and I do not know where he lives. I wish also, you would read the letter, and if you think there is anything in it, that you would not have me to say to him, suppress it.

I wish you would read the *Dedication* and *Preface* to my late *tract on phlogiston.* If I had thought the subject interesting to you, I should have sent you a copy. I am busy about some important experiments. Were you here I would not despair of exciting your attention to other things besides *theology* or *metaphysics*, tho' these are certainly of the first consequence, and I give most of my time to them.

I am, dear sir,
[Signature cut out.]

P. S.—Cannot you make this place on your way to the federal city, where I suppose Congress will meet the next year ?

DEAR SIR :—

I was much amused with the account of your being *taken in* by my treatise on *phlogiston.* In the future mind the old adage *Fronti nulla fides.* However, if you get *anything* for your half dollar it was not wholly thrown away, and you will be wiser another time.

I have lately been reading *Robinson's History of Baptism*, and it has led me to put down some thoughts on the subject, which I shall probably reduce into the form of a *tract*, and send to England after the Essay mentioned in my last. But I want to examine one of Mr. Robinson's references to the Works of St. Austin. My set is not compleat, one volume having been destroyed in the riots ; and unfortunately the treatise referred to is in that volume. But *Austin's Works* I see are in the *Loganian library*, No. 84, Folio, in 8 volumes. I shall therefore be much obliged to you if you will consult it for me. Mr. Robinson says, p. 218, "Had he" (Austin) "forgot himself when he taxed the Pelagians with denying infant baptism ;" and in the margin refers to the treatise. *De Peccaborum meritis, Lib.* 2, *Cap.* 25 (or Penatorum.—E. N. H.). This is the tract that my set is deficient in. He has another reference to a treatise which I have ; but it contains nothing to his purpose, and therefore I strongly suspect that the other does not. In other places Austin takes it for granted that the Pelagians, as well as all other christians, allowed of infant baptism ; and from this he draws an argument against them. Mr. Robinson had good sense, and a strong imagination, but he is not always to be depended upon, tho' he was far from intending to mislead his readers.

Some time ago Mr. Lindsay sent me *King's History of the Greek Church*, 4to., but having it before I sent the other to Mr. Dobson to sell for me. I wish you would inquire whether it be sold. It is a valuable work, and worth your having. I also sent him the 3d vol. of *the Transactions of the Philosophical Society at Philadelphia*, to have the 4th bound like it. Please to inquire whether it be done, and if so, let them be sent to Mr. Vaughan, who will send them hither the first opportunity.

Did you receive, and forward, my *Letter to Noah Webster?* I thank for your care of the others. (The momentary confusion in the mind of Priestley in writing the last sentence shows the advanced years or fatigue of the great man. It is a literal transcript of the original.—E. N. H.)

Yours sincerely,
J. PRIESTLEY.
NORTHUMBERLAND, Apr. 23, 1800.

P. S.—*The Commentaries & Essays*, is a work that you should have. There are only four Nos. of the second volume printed.

May 10, 1800.

DEAR SIR :

I am sorry on your account, as well as my own, that you have forgotten your *Latin ;* but certainly it is not now worth your while to endeavor to recover it. I am writing to Mr. Balsham, and I desire him to consult the passage for me. I now and then want books that I cannot get here, but in this situation I the more value those that I have, and read many that I should never have read in England, where I had greater choice, and I have found much advantage in it, so that some good results from every evil. I am now reading with much satisfaction *Bingham's Ecclesiastical Antiquities*, a learned and laborious work ; but though I have long had it, I should never have done more than consult it occasionally, in any other than my present situation. For my philosophical pursuits I am nearly as well furnished as I ever was in England ; but I want more early intelligence of what is doing there, and especially in France. I am much interested in the restoration of the intercourse with that country, and hope it will soon take place, unless the apprehension of a war with England in consequence of it should prevent it.

I am glad to hear you say that the *reign of terror* will soon terminate. If the *effect* cease, I shall not much mind the *cause.* On this subject, and the influ-

ence of France in this country. I differ from you *in toto;* but as it is not likely that anything I could say would change your opinion on these subjects, I shall not trouble you with it. I believe your motives to be as pure as my own, nor can I disapprove what you say of *ignorant sincerity;* but we differ widely in the application of general maxims to particular cases. I thank you for the news from New York. My correspondents there are Dr. Mitchell and Chancellor Livingstone; but our subjects are altogether philosophical. I should not have known, from anything that has come from Dr. Mitchell whether he was a Federalist or otherwise. I am glad, however, to find that he is on the *right side.*

When I look at the map, I do not think that your way to the Federal city by this place from New York is much longer than by Philadelphia. If so, I still flatter myself that you may look in upon me in going to or returning from Congress. The difference cannot be much. I would go further than that to see you.

In my last I mentioned our preservation from poison. Our physicians, however, say there was nothing but *tartar emetic* in what we took; and having examined what remained of the flour, I do not find any certain sign of arsenic in it; so that there is no proof that any serious mischief was intended.

I do not know what to think of Buonaparte, but I cannot help being apprehensive of the fate of England. By accounts from my son, the scarcity there approaches to a famine. The deaths in London are more than ever was known since the great plague. All provisions are almost three times the usual prices, and yet they will not hear of *peace.* It is like that *infatuation* which, as Hartley observes, generally precedes destruction. My consolation is that *the Lord reigneth, let the earth rejoice.*

Yours sincerely,
J. Priestley.

P. S.—I have received no letter from Mr. Dobson. I am sorry that Congress is breaking up, as you will probably leave Philadelphia, if you have not already left it.

The following letters were read by Prof. Pynchon, of Trinity College, Hartford, Ct.:—

Birmingham, June 24, 1782.

Dr. Benjamin Franklin:—

Dear Sir: You have made me very happy by your letter, as I find by it that notwithstanding the unpleasant state of politicks, your usual humor and pleasantry has not forsaken you. I am only concerned that you have not mentioned the case of my friend, *Mr. Russell,* about which I wrote you so particularly. But I have taken the liberty to assure him, that, notwithstanding this omission, I am as confident that you have not neglected the business, as if you had given me the most expressed assurance of it. One line, however, informing me what you think of the case, will give me great satisfaction.

Having at length got *sunshine,* I am busy in prosecuting the experiments about which I wrote to you, and shall soon draw up an account of them for the Royal Society.

Please to inform the Duc de Rochefecault, whose civilities to me I remember with pleasure, that my experiments are certainly inconsistent with Mr. Lavoisier's supposition of there being no such thing as phlogiston, and that it is the addition of air and not the loss of anything that converts a metal into a calx. In their usual state calces of metals do contain air, but that may be expelled by heat, and after this I reduce them to a perfect metallic state by nothing but inflammable air, which they imbibe *in toto,* without any decomposition. I lately reduced 101 ounce measures of this air to two by calx of lead, and that small remainder was still inflammable. I explain Mr. Lavoisier's experiments by supposing that *precipitate, per se,* contains all the phlogiston of the metal mercury, but in a different state; but I can show other calces which also contain more phlogiston than the metals themselves. That mercury in its metallic state does contain phlogiston or inflammable air, is evident from the production of nitrous air by the solution of it in spirits of nitre, and I make *nitrous air* from nothing but *nitrous vapor* and *inflammable air;* so that it indisputably consists of those two ingredients. I have already ascertained the proportion of inflammable air that enters into the composition of lead, tin, copper, and silver, and am proceeding to the other metals as fast as I can. When the whole is completed I shall give you a further account of it.

I am exceedingly concerned to find that it is so difficult a thing to make *peace;* but I hope before the campaign is over, all parties will have had enough of *war,* and be sensible that they will gain nothing by continuing it. If I had any voice in the business, the prospect of seeing you in this country would be a strong additional motive to accelerate the negotiations.

With the greatest respect and every good wish,

I am, dear sir, yours sincerely,
J. Priestley.

P. S.—If you should think it proper, I have no objection to your sending a copy of my former letter to *Rosier's Journal,* as a general outline of what I am doing. I wish to have every new fact to be as speedily and as generally known as possible.

London, 12 Feb. 1775.

Andrew Oliver, Jr., Esq., *Salem, Massachusetts:*—

Sir: I think myself exceedingly obliged to you, for the communication of your excellent observations on the cause of the electricity of the atmosphere. As far as I can judge of them from the general ideas you throw out, they promise to unfold that great secret of nature which has hitherto been one of the great desiderata in philosophy. I shall be very glad to see your thoughts on this subject more at large.

I have read your *Essay on Comets* with attention and pleasure. My objection, however, to your theory is, that the atmosphere of the comets being of the same nature with those of the sun and other heavenly bodies, the particles of which they consist will not be expelled by them more than by each other; so that upon their approach, they will only surround the two bodies to an equal distance. How could the atmosphere of the sun, for instance, drive that of a comet to such a distance, when no part of that of the sun itself is driven by the same power to a tenth part of the distance? But I think your hypothesis will stand clear of this objection, if you suppose, what I believe to be true, that the sun and the comets, as well as the earth, have *proper electric atmospheres,* by means of which they will be enabled to act upon their ordinary atmospheres at a considerable distance.

I rejoice much that philosophical knowledge is so much cultivated on your side of the Atlantic, and sorry I am that our attention to it will probably be called off

to a struggle for power, the most unnatural and I fear the most fatal that men were ever engaged in.

I have of late been very much engaged in the prosecution of my experiments on different kinds of AIR and have had considerable success. I intend soon to publish a *supplement* to the treatise which you very probably have heard that I have lately published without subject. If there is any intercourse between the two countries at that time, I shall send you a copy, and shall be exceedingly glad to hear from you.

I am with great respect, Sir,
Your obliged humble servant,
J. PRIESTLEY.

P. S.—L'd Shelburne desires me to present his most respectful complements to you.

NORTHUMBERLAND, April 3, 1800.

DR. B. LYNCH OLIVER:—

SIR: I do not know whether you can forgive my neglecting to answer your obliging letter of so old a date as February, 1797; when I can only say that when I received it I was from home, and not at leisure to write, and that I afterwards forgot it, and when I recollected it I was ashamed to acknowledge it. If you can, please to accept a pamphlet I take the liberty to send you on a subject that is very interesting to chemists. I have since that completed a course of experiments in pursuance of those on *the generation of air from water*, the result of which is that, by repeated freezing of the same water, I always get from it a quantity of air, and to appearance without any limit; so that the whole might be converted into this kind of air as well as by previously converting it into vapor. By this means the atmosphere may constantly receive an addition to this ingredient in its constitution, as the other part, viz., dephlogisticated air is recruited by the influence of light on plants.

I thought I had had the volume of the American Transactions to which you refer, but I find I have no more than the first volume, but I have somewhere seen it, and I think Mr. ——— makes the difference of heat to depend upon the difference of purity in the air in different seasons. If so, he must be mistaken, for I find no sensible difference in the purity of the air at any time, or, indeed, between the air of this country and that of England.

I am not very well acquainted with the doctrines of *galvanism*, but it should seem that the different metals are in different states with respect to electricity, though it is very extraordinary that this should be the case. This is a curious and important subject just opening upon us.

I have always heard a good account of Mr. Titler, both as a man and a philosopher, but I have no personal knowledge of him.

I rejoice to find that in you that philosophy is joined to Christianity, from which it is too much separated. With me this is a primary object, and philosophy, much as I have attended to it, only a secondary one, as my writings here as well as in Europe will show.

Please remember me respectfully to your father, if, as I hope, he be still living. He is very obliging to inquire after my welfare, and assure him that I find in this country everything that I expected from it, or that I wish for in this world. I have convenience and leisure for my pursuits of every kind, and I shall endeavor to make as much use of them as I can. I want only such things as must be had from Europe, and more early intelligence of what philosophers are doing there. But this inconvenience will be removed after the present war, which cannot, I think, continue much longer, shall cease. With the greatest respect I am, sir,

Yours sincerely,
J. PRIESTLEY.

NORTHUMBERLAND, Aug. 8, 1800.

DR. B. LYNCH OLIVER:—

DEAR SIR: I thank you for the valuable present of Mr. Tytler's treatise. It is a very interesting work, and I shall read it with particular attention, not only on account of the principal object of it, the investigation of the nature of pestilential disorders, but on account of the great mass of collateral subjects I perceive he discusses, especially the doctrine of *heat*, concerning which I have long been unable to form any satisfactory opinion. When I have perused the work, I shall take the liberty to propose to him or to you any question that may occur to me on that subject, or any other that he has introduced. I see that in his account of plague in the appendix, he has not mentioned the most extensive and fatal of any that we read of, in that of 1348, in the time of Petrarch, which seems to have swept off one-third of the human race.

Mr. Tytler's opinion in favor of my objections to the new theory, I think of much value, and I am well persuaded that the more attention is given to the subject, the more groundless that system will appear. Many I hear suspect it in England, and there has been a serious attack made upon it in France, but by whom I have not learned. We shall soon, I hope, have a communication opened with that country, and then I shall know more particulars. The want of it at present is a great obstruction to the progress of science, but this is no object with politicians.

My experiments on the perpetual production of phlogisticated air from water, both by means of a vacuum and by freezing, I think absolutely subversive of the hypothesis of the re-solution of water into inflammable and pure air. I have made both with the greatest care, and do not at present foresee that any sufficient objection can be made to either of them; agreement with each other is a striking circumstance. Your objections to the new nomenclature are certainly very just.

The objections that Mr. Tytler makes to Count Rumford's experiments did not strike me at the time that I read them, but I shall now attend to it more particularly. I have not yet seen Noah Webster's book on the Plague, but intend to procure it. What do you and Mr. Tytler think of it? I wish we were nearer to each other.

I am, with my respects to Mr. Tytler,
Dear sir, yours sincerely,
J. PRIESTLEY.

P. S.—I have printed at my own expense *a comparison of the institutions of the Hindoos and other nations with those of Moses*. Could you assist me in the disposal of a few copies in your neighborhood?

ADDRESS AT THE GRAVE OF JOSEPH PRIESTLEY.

BY HENRY COPPÉE, LL.D.,
Of the Lehigh University.

It is known to all assembled here this evening that Professor Henry was expected to make the address on this august occasion; that the oldest and most distinguished of American scientists was to honor American science here, in honoring the memory of Priestley.

When it was announced to the committee, greatly to their regret, that Prof. Henry was prevented from coming by temporary illness, they urgently requested me to perform that duty. Although I am very much flattered by such an appointment, I have accepted it with the greatest reluctance; not because I do not venerate the name of Priestley; not because I am not ready to add my humble tribute to the ovation of this centennial gathering; but because I cannot stand in the place of Prof. Henry, and must disappoint those who have come here to listen to his counsels. I therefore crave the indulgence of all who are present for the few words which I shall utter, hastily thrown together, without materials with which to work, and without time to combine and digest such materials if they were at hand.

Fortunately, however, my task is rendered easier, or rather less important, by the masterly essays to which you have already listened. You have heard from Prof. Croft the story of his life, and the unusual severity of his trials and labors. Prof. Hunt has given us a glimpse of the colossal superstructure which has been raised upon the solid foundation, of which—strange paradox—dephlogisticated air is the chief corner-stone.

It only remains for me to draw some moral from the story and the progress, and like the preacher to point to those features of the distinguished scientist at whose grave we stand, which offer to all food for thought, models for imitation, and divine lessons of human philosophy.

The chemists as a special class have gathered in this grateful pilgrimage, but Dr. Priestley, as you have heard to-day, was more than a chemist. He was a theologian, a political economist, a civilian, a physicist, a student of history, a teacher of men.

Indeed, while objectively his great discovery in chemistry remains and will remain a wonderful fact, and a wonderful factor in chemical science, the progress of that science, since his day, has so far left behind what he knew, of principles, of material, and of apparatus, that he appears already principally as a personage in chemical *history*. Like Bacon, he pointed the way to the rich domain which he was not able to enter. So too in the broad fields of physical science, with all its varied interests, the world has moved rapidly since his day. Could he rise from this sod, and hear and see the wonders of science and the marvels of art on every side, what would be his astonishment at the photograph of his own picture which you have seen to-day; at the crowds that have came by railway expresses to do him honor; at the announcement, that under the ocean waves, the lightning, which he gloried to handle, was sending, from this Priestley centennial gathering in Northumberland, an instant flash of greeting to the crowds who three thousand miles away will make the welkin ring to-morrow with plaudits, when his statue is unveiled at Birmingham; that Birmingham which a little more than three-quarters of a century ago, sacked his laboratory, burned his house, and drove him and his children away and out of England, with a ferocious bigotry, which was not essentially English, but which belongs to human nature in all ages, and was specially characteristic of that age in Europe.

But in political economy, in jurisprudence, in ecclesiastical policy, and in history, he is still of value to the scholar and the patriot. He was a reformer, who saw in the condition and constitution of England much to be amended. The rigor of the church establishment aroused his righteous anger. He took the field against all comers: the Archbishop of Canterbury, the great orator Burke, the renowned Blackstone, the Board of Longitude; and he dictated to all, toleration and universal liberty. If he was a century in advance of his age, so much the greater his merit.

Many years ago, when I was a young student of history, there was put into my hands as one of the books to be read, a copy of Priestley's Lectures on History and General Polity. The copy which I used was published at London in 1793, the year before he came to America, and dedicated to Benjamin Vaughan, one of his favorite pupils. This book, although he says it was intended "for students and not for proficients," marks a great step in the study of modern history, and is one of a series, the other two being one on the history of England, and one on the laws and constitution of England. They were delivered while he was a tutor in the academy at Warrington. I am struck with the freshness of his inquiries; his estimate of the numismatic element; his views of the connection between history and law; anticipating Mr. Froude in his suggestion that history can only be properly written from the statute book. I would refer also to his lecture on the use which Newton made of the procession of the equinoxes in rectifying ancient chronology. His restless mind brought to the consideration of history all the new lights of science and philosophy, and suggested the modern methods of study now in use.

Of his theological opinions, I have nothing to say; we may differ from them; some of us do; we must respect them; he believed that he was right; he was right to uphold his belief against bigoted orthodoxy; he was persecuted for righteousness' sake. He came to this beautiful spot to find a refuge from political and religious storms; he found and proclaimed freedom to worship God!

At the risk of exhausting your patience, I must say a word concerning his views of education. He begins his essay on education with words which might be used by a modern educational reformer, who, without entirely discarding the old training, asks a hearing and a place for the new.

"It seems to me," he says, "a defect in our present system of public education that a proper course of studies is not provided for gentlemen who are designed to fill the principal stations of *active* life, distinct from those which are adapted to the learned professions."

"So remote," he adds, "is the general course of study at places of the most liberal education among us, from the business of civil life, that many gentlemen, who

have the most liberal education their country could afford, have looked upon the real advantages of such an education as very problematical, and have dispensed with it in their own children." We have not time to dwell upon this admirable essay; it was published in 1764, one hundred and ten years ago; but it displays such a distant forecast that it needs only a little modification to be of practical utility to-day.

Seventy years ago Priestley died in this town of Northumberland, regretting that he must abandon the pursuit of truth on earth. There was no sordid clinging to the fleshly tenement. He had the spirit of the old heroes of science and art, who fell beside their retorts, or who bowed their heads in sleep over immortal manuscripts, in which they yet wake and live and speak again in tones which sweep the diapason of the human heart.

When Prescott had conceived the plan of one of his splendid histories, he wrote to his friend Ticknor, "*Da Jupiter annos*:" years to labor and achieve. When Priestley found his life ebbing away, he only asked his physician to patch him up for six months longer, that he might complete the printing of his works.

Thus to the masters of science, overmastered at last by science, death has no terror but that of loss of usefulness in the demonstrations of truth to a needy and expectant world.

To my mind Dr. Priestley appears as always the ardent champion of truth and right. He has been called dogmatic and controversial. I think he was. If he caught, as through thick forest leaves, a glimpse of truth, no power on earth could restrain him from pursuit; it mattered not what the guise or garb; a voice within cried "follow," and drowned the expostulations of the timid, the temporizing, and the intolerant. If he saw injustice in high places or low, he must couch his lance and rush to the assault; he may have been sometimes injudicious, he seems to me to have been always honest. The spirit which prompted and pointed his opposition to injustice in England, was not burnt out when he came to America. His pen was busy when the alien and sedition laws of the elder Adams were passed, and when he, as a resident not naturalized, was exposed to their noxious application.

Thus it happened that he was a pantologist. It has been said that had he limited his attention to one subject of science or literature, he would have been pre-eminent in that.

Those have very superficially examined his character who think it was possible for him to do so. Portions of truth are found in all sciences, in all pursuits, in all ages. He would take no partial view; he seems to have desired the possession of the truth, the whole truth, and nothing but the truth; and was especially eager to observe when truth was in danger, that he might rescue her.

The great pensionary of Holland, in prison and in prospect of death, was heard muttering as words of consolation to himself in that dark hour—*justum et tenacem propositi virum.*

I like to think that a similar solace was often in the mind of Priestley, in his troubles in England, and that these words may be properly quoted in his eulogium to-day.

Priestley was a reformer. By this is meant that not only did he desire to eradicate wrong from all systems, but also to search for new methods in science and in government, which would usher in a better order. Thus the reformer becomes a discoverer; he analyzes to reconstruct, but also to discover new elements, which will give use to new and better forms of reconstruction; and in this respect his example is of great value to the young scientists of to-day. To know what is already known, to be up to the latest developments of science, is not enough to secure fame.

The man who will send his name down in the history of his science, is the one who advances it, who discovers something new; who establishes an hypothesis so that it becomes a metaphysical theory; who makes his science and the world his debtor for all time; a debt which annual or centennial instalments of gratitude will thankfully acknowledge, but can never pay off.

Such was the ardor of Priestley, and such I know to be the guiding motive, the recognized incentive, of the men who have assembled here to honor the labors of Priestley.

Brethren in the large domain of human culture, let us gather new enthusiasm at this grave. We approach this tomb not in sorrow, but in triumph; because he was a great scientist; because he brought his labors and his fame from intolerant England to a welcoming America; because he was a man of large and varied learning; because he was a righteous man, honest, true, just, and pure; and because, in honoring all these traits, we wish to place so notable an example prominently before the young men who are pursuing science in our midst.

And to our fair friends who have graced this celebration with their presence, and their kind attentions, I dare to set forth in all honor the beautiful example of Priestley's wife. She recognized her husband's gifts; she shared without a murmur his trials; she gloried in his achievements. Bearing the burden of the household, she left him uninterrupted to pursue his studies. Hear his own words: "My wife was a woman of excellent understanding, much improved by reading, of great fortitude and strength of mind, of a temper in the highest degree affectionate and generous, feeling strongly for others, and little for herself. Also greatly excelling in everything relating to household affairs. She entirely relieved me of all concern of that kind, which allowed me to give all my time to the prosecution of my studies, and the other duties of my station." My fair friends, I need not further point the moral; I cannot further adorn the tale.

This is an unusual celebration, and this particularly is the strangest scene of this singular drama. This peaceful field, an acre of God, at this most charming evening hour, happily suggested by a lady chemist; these surrounding hills, this gleaming river, which lend

breadth and beauty to the landscape; this distinguished assemblage standing reverently, but not mournfully, around a grave: these do not tell us of death, but of life; breathing, varied, sunny life: not of decay, but of resurrection; not of oblivion, but of immortality.

They tell us that in the memorable past there is but a semblance of imprisonment; that the good and the true, the magnanimous and the noble, break the flimsy bonds, and come back to gladden the hearts of men, and to flourish in perennial beauty.

> "Thou unrelenting past ——
> * * * *
> Alone shall evil die,
> And sorrow dwell a prisoner in thy reign."

Such are the pleasant thoughts, fancies, and yet living facts, which cluster around the grave of JOSEPH PRIESTLEY.

A CENTURY'S PROGRESS IN CHEMICAL THEORY.

BY T. STERRY HUNT, LL.D., F.R.S.

To write the history of the progress in chemical theory during the last one hundred years would require a discussion of the growth and development of the whole of modern chemical philosophy, since the past century has seen the rise of nearly all the ideas which now find a place in our science. On endeavoring, therefore, in the hour before me, to acquit myself of the honorable task which you have imposed upon me, I can do little more than review in a rapid manner what seem to me some of the more important stages in the theory of chemistry, so that my sketch, though necessarily meagre, shall not be a faithless one. Previous to the time at which our review begins much chemical knowledge had accumulated. To that brought from the east by the Saracens had been added the experiences gathered by the apothecary, the dyer, the glass-maker, and the metallurgist, but chemistry was still an art rather than a science, and the method of the schoolmen was not favorable to the creation of a sound chemical theory. Becher and his disciple, Stahl, had, it is true, already protested against the Aristotelian philosophy, with its four elements, and had led the way to a true conception of the nature of chemical species. To the former we owe a clear definition of the distinction between bodies decomposable and undecomposable; but when this idea is further interpreted by Stahl, we find that the oxides were regarded as simple bodies, and the metals as compounds of these with phlogiston, the supposed fiery element; which was conceived to exist in a nearly pure state in carbon and in inflammable air or hydrogen. We are aware to-day that the balance gives to this phlogistic theory a formal refutation, and the fact itself did not escape Stahl, who expressly tells us that an earth or calx, by fixing phlogiston, is diminished in weight. Notwithstanding its palpable contradictions, this phlogistic theory, however, held its place for more than fifty years after the death of Stahl, and found its last defender in Priestley.

At the beginning of the century which closes with this anniversary, the curtain rises upon three illustrious chemists who, more than all others, have contributed to build up the science; it is scarcely necessary to name Scheele, Priestley, and Lavoisier. The first, wonderful in experiment and untiring in industry, discovered several bases and numerous acids, both mineral and organic, including hydrocyanic acid, indicated fluorine, made known chlorine, and recognized, almost at the same time with Priestley, the nature of oxygen and the composition of the atmosphere, of which he made an analysis. He however fell into curious errors as to the nature of the fiery principle of the air which, according to him, combined with phlogiston to produce both heat and light. Priestley, on the other hand, not less ingenious as an experimenter, and fertile in invention, devoted himself to the study of gases. Previous to his researches the only artificial gases recognized were carbonic acid and hydrogen, known as fixed and inflammable airs, to which number he added no less than nine, including hydrochloric and ammonia gases, sulphurous acid, carbonic oxide, nitrogen, and its two oxides, and finally oxygen itself; a discovery which was soon followed by the recognition of its relation to the respiration of animals. Priestley is justly called the founder of pneumatic chemistry, but, with a knowledge of oxygen and its relation to respiration and combustion, he failed to interpret aright his great discoveries, and remained till the end of his life a partisan of the views of Stahl and a believer in phlogiston. To the last he raised his voice against the doctrines of Lavoisier, and from this, his western home, sent to the French Academy of Science his protest against the new views.

Let us turn now to Lavoisier, that prodigious genius who appeared on the horizon of our century, a rising sun soon, alas! to be quenched in blood. The labors of Lavoisier extended from 1770 to 1794, and in this period we find that, not content with adding discovery to discovery till he showed himself, as an experimenter, the rival of Scheele and of Priestley, he gave laws to the science, revealed the hitherto hidden harmonies of the world of matter, and, another Newton, established upon a basis as yet unshaken the science of modern chemistry. To him, conjointly with Wenzel, we owe the systematic use of the balance in experiment, which made of chemistry a quantitative science. Repeating and verifying the researches of Priestley as to the nature of oxygen and the constitution of the atmosphere, the composition of which he established accurately both by analysis and synthesis, he next investigated more thoroughly the respiration of animals, and studied the combustion of organic bodies, which he found to yield both carbonic acid and water. The reactions between mercury and the acids which had yielded to Priestley the sulphurous and nitric oxide gases, were next studied, and the quantitative relations of these reactions determined. The nature of water, which appeared in so many processes of combustion, then engaged his attention, and he shares with Cavendish the merit of the independent discovery

of the composition of water, which was quantitatively determined by him both analytically and synthetically. At last, after years of careful investigation, controlling alike his own discoveries and those of his contemporaries with the aid of the balance, Lavoisier had firmly established the bases of his grand theory, which he now gave to the world, demolishing the phlogistic hypothesis of Stahl, showing the simple nature of oxygen, its union with the metals to form calxes or oxides, and with sulphur, phosphorus, and carbon to generate acids. The true natures of the metals, earths and acids, of air and water, and of organic bodies were determined, the phenomena of fermentation, combustion, respiration, and animal heat were explained, and the new chemistry was created. In the various transformations of matter it was shown that there was nothing lost and nothing gained, and no place was left for the imaginary phlogiston. We here find reiterated and justified by modern discovery the old doctrine of the Egyptian philosophers, preserved to us in that wonderful book known by the name of Hermes Trismegistos, where it is written: "Nothing perishes, nothing is destroyed, but that which is composite divides itself, and life consists in an incessant and necessary transformation." The more we look at the chemical work of Lavoisier the more we marvel at his genius, at his unerring judgment, and the breadth of his vision, and if we follow him into the domain of chemical physics his generalizations are not less wonderful. He, however, left a great work for his followers.

All things, says the sage, are ordered by weight, by measure, and by number, yet with the balance in hand Lavoisier does not seem to have comprehended this grand truth, although his quantitative determinations of the composition of water, both by weight and by measure, really furnish a striking example of it. The nature of the saline combinations formed by the union of acids with bases was, in like manner, but little studied by Lavoisier; and it was Wenzel, whose researches in chemical affinity appeared in 1777, who made known the important facts that in the double decomposition of neutral salts the resulting compounds are neutral, and that the elements of the two salts employed are found complete in the products of the reaction, so that here again nothing is lost and nothing gained. Carefully controlling all his experiments by weighings, he laid the foundation of chemical statics. The succeeding researches of Richter and of Proust established the numerical relations between combining bodies, and thus prepared the way for the great generalizations of Dalton, who, in 1807, summed up the long labors of Wenzel, Richter, Proust, and his own in his theory of definite and multiple proportions. Dalton, as you are aware, linked his discoveries with the old hypothesis of the atomic constitution of matter, which is, however, by no means necessarily connected with the great laws of combination by weight and by number. It was reserved for Gay-Lussac to make known a not less beautiful generalization, by showing that in the combination of vapors and gases there exists an equally simple relation of volumes, and that measure, not less than number and weight, governs all chemical changes.

The combining proportions of the elementary bodies, when compared with oxygen, as was done by Berzelius, exhibited no simple relations among each other, but when hydrogen was taken as unity such relations appeared as led Prout to conjecture that some law, like that which regulated the equivalent weights of admitted compounds, would be found to prevail among so-called elements, and, moreover, that they were all multiples of hydrogen by some whole number; a conclusion, however, which seemed irreconcilable with the most careful determinations of equivalent weights. On the other hand, the curious numerical relations between the equivalents of bodies of similar chemical character attracted strongly the attention of chemists. As early as 1829 Dobereiner called attention to the triads of related bodies, such as the groups of lithium, sodium, and potassium, and of calcium, strontium, and barium, in which the equivalent weight of the middle term is the mean of that of the extremes. Almost simultaneously, and apparently independently, Pettenkofer and Dumas took up again the question, in 1851, and called attention to the fact that the numerical relations between these and many other mineral radicals are similar to those between the organic radicals known to result from the condensation of successive equivalents of carbon and hydrogen, such as the olefines, the paraffines, and the alcohol radicals. The possibility that the mineral radicals, related alike in chemical characters and in equivalent weights, might, also, be composite bodies, was suggested by Dumas in 1857, and with this in view he undertook a re-examination of the equivalent weights of the elements. If, as the numbers adopted by Berzelius seemed to show, no simple ratios existed between those of related elements, the suggestion of Dumas was inadmissible; but if, on the contrary, as supposed by Prout, a simple and exact relation of this kind was established, it was not impossible that the view of their compound nature might be true.

The results of many years of patient labor, devoted to a re-examination of the equivalent weights of a great number of bodies, were given to the world by Dumas in 1859, and from these he concluded that the law of Prout is so far true that the equivalent weights of the elements are multiples of a unity which is one-fourth that of hydrogen; so that, if $H = 1$, we shall still have such fractions as $Cl = 35{\cdot}5$, and $Al = 13{\cdot}75$. These results and the analogies between the elements of mineral and of organic chemistry, both in chemical relations and in equivalent weights (which in the mean time had been carefully investigated and developed by J. P. Cooke), now led Dumas to reaffirm his conjecture that the mineral radicals may really be compounds, though their decomposition is perhaps beyond the possibilities of our chemical analysis.

Among the most significant advances in chemical theory are those relating to the action of heat on bodies. If we define chemistry, as I have been tempted

to do, as that science which treats of the relations to one another of the different forms of mineral (*i. e.* unorganized) matter, and their transformations under the physical agencies of heat, light and electricity, we shall see how difficult it is, in a sketch like this, to draw the line between physics and chemistry. This becomes still more evident when we see in light the chemical constitution of matter, as it were, revealed and made visible to us by the spectroscope, or study the electric current parting in a mysterious manner the components of bodies. Time would fail us to follow the trains of thought thus opened, but I cannot forbear to say somewhat of the relations of temperature to chemical species, and of the power of heat to unloose the bonds of chemical combination. The admirable researches of Grove, followed by those of Henri St. Claire Deville and his fellow-laborers, have shown us that at an elevated temperature such bodies as water, hydrate of potassium, and hydrochloric acid are more or less completely resolved into their constituent elements, the affinities of which are suspended. In this principle of dissociation by heat we have an explanation of many chemical reactions hitherto enigmatical. The decomposition of bodies by heat is, moreover, assimilated to the phenomenon of volatilization ; the rate of decomposition at a given temperature varying with the pressure, and with the nature of the atmosphere which surrounds the unstable body. The phenomena of dissociation are seen in a wonderful degree in the sun, the fixed stars, and the nebulæ. It is not necessary to recall to you the marvellous field of celestial chemistry which the spectroscope, in the hands of Kirchoff and his followers, has made known to us, nor to the proofs that the solar atmosphere contains in a dissociated state very many of the elements which in our own planet are met with in a free state only in the laboratory of the chemist. It is instructive to compare the spectra of the various fixed stars with each other, from white stars like Sirius, to yellow stars like Aldebaran and our own sun, and red stars like Alpha Orionis and Antares, and to note in these three classes an increasing complexity of chemical composition. In the first, with a predominance of hydrogen, we see only faint lines of magnesium, sodium, calcium, iron, and a few other metals, while in the second, though free hydrogen still abounds, the number of metallic elements is greatly augmented, and finally in the red stars hydrogen is seen only in combination, as aqueous vapor, the metals are wanting, and the metalloids and their compounds appear. If, in accordance with the nebular hypothesis, we look upon these different types of stars as representing successive stages in the process of condensation from nebula to planet, we may also see in them a gradual evolution of the more complex from the simple forms of matter by a process of celestial chemistry. Such was the view put forward by F. W. Clarke in January, 1873, and some months later by Lockyer, who has reiterated and enforced these suggestions, and moreover connected them with the speculations of Dumas on the composite nature of the elements. The white stars are the hottest, and in the atmosphere of these bodies the various metals, according to Lockyer, make their appearance in the order of their vapor-densities.

I ventured in 1867, while speculating on the phenomena of dissociation, to remark, that, although from the experiments of the laboratory we can only conjecture the complex nature of the so-called elementary substances, we may expect that their "further dissociation in stellar or nebulous masses may give us evidence of matter still more elemental." Now, while the nebulæ when scanned by the spectroscope show us only the lines of hydrogen and nitrogen, the two lightest forms of gaseous matter known to chemistry, it is remarkable that the recent studies of the solar chromosphere reveal to us the existence of an unknown gaseous element which, from its extension beyond even the layer of partially cooled hydrogen, must, according to the deductions of Mr. Johnson Stoney, be still lighter than this gas. The green line by which this substance is distinguished is not as yet identified with that of any terrestrial element. Is it not possible that we have here that more elemental form of matter which, though not seen in the nebulæ, is liberated by the intense heat of the solar sphere, and may possibly correspond to the primary matter conjectured by Dumas, having an equivalent weight one-fourth that of hydrogen? Mention should also be made of the unknown element conjectured by Huggins to exist in some nebulæ. This conception of a first matter or *Urstoff* has also been maintained by Hinrichs, who has put forward an argument in its favor from a consideration of the wavelengths in the lines of the spectra of various elements.

It is curious in this connection to note that Lavoisier suggested that hydrogen, nitrogen, and oxygen, with heat and light, might be regarded as simpler forms of matter from which all others were derived. The nebulæ, which we conceive as condensing into suns and planets, show us only two of the three elements of our terrestrial envelope, which is made up of air and aqueous vapor. If now we admit, as I am disposed to do with Mattieu Williams, that our atmosphere and ocean are not simply terrestrial but cosmical, and are a portion of the medium which, in an attenuated form, fills the interstellary spaces, these same nebulæ and their resulting worlds may be evolved by a process of chemical condensation from this universal atmosphere, to which they would sustain a relation somewhat analogous to that of clouds and rain to the aqueous vapor around us. This, though it may be regarded as a legitimate and plausible speculation, is at present nothing more, and we may never advance beyond conjecture as to the relation of the various forms of so-called elemental matter, and to the processes which govern the evolution of the celestial spheres. You will, I trust, pardon this excursion to the regions of space and the realm of imagination into which I have led you, and return with me to the consideration of a new chapter in chemical theory.

It soon became evident from the researches of Lavoisier, and the subsequent ones of Berthollet, that from

the four elements, carbon, hydrogen, oxygen, and nitrogen, are compounded the various products of the vegetable and animal kingdoms, and with the study of these compounds grew up the so-called organic chemistry. So long as the results of the ultimate analysis of these bodies were represented centesimally, their constitution remained obscure, but slight variations in composition being found between species widely unlike in chemical and physical properties. When, however, in accordance with the law of equivalents, it was possible to construct from their analyses formulas for these bodies, and when for volatile compounds, like alcohol and ether, Dumas had applied Gay-Lussac's law of volumes, by determining the density of their vapors, the foundation of a rational system of organic chemistry was laid; and the conception of types, in which one element could be replaced by another, was introduced into the science by Dumas. The multiplication of similar bodies, like the alcohols and their related acids, with varying equivalents and vapor-densities, led to comparisons which soon resulted in the conception of series. It was found that if spirit of wine could be regarded as a hydrate of olefiant gas, other related bodies were hydrates of other hydrocarbons having the same centesimal composition as it, but more or less condensed. It thus became possible to represent bodies so related in composition and properties by a common formula, as members of a series, differing by nCH_2. The first conception of this great step belongs to Dr. James Shiel, of St. Louis, and was afterwards systematically carried out by Gerhardt, who gave to bodies so related the name of chemical homologues.

But here arose another question: Guyton de Morveau had in his first essay at a chemical nomenclature, in 1782, ranged alcohol with lime, silver, and phlogiston, as a base capable of saturating acids, thus assimilating the ethers to salts, and when in the light of modern chemistry these ethers were further studied, spirit of wine was described not as a hydrate of olefiant gas, C_2H_4, but as a hydrated oxide of ethyl, comparable to hydrate of potassium, in which the group C_2H_5 played the part of potassium. Here was a hydrocarbon group assimilated to a metal—an electro-positive compound radical, in the language of Berzelius; while in cyanogen was found another group similar in its relations to chlorine—an electro-negative compound radical. You are aware of the extent to which this new view was carried, and how the analogies of the mineral oxygen-acids led to the extension of a similar view to the organic acids, so that vinegar was said to be the hydrated teroxide of a hydrocarbon-radical, acetyl, and in accordance with the binary theory of salts, the acetates were compounds of an anhydrous acetic acid with a metallic oxide. Organic chemistry was defined by Liebig to be the chemistry of compound radicals, and soon this notion was carried into mineral chemistry also. The analogies between the compounds of chlorine (the so-called haloid salts), and the salts of oxygen-acids, led to an attempt to assimilate these latter to the type of the haloids, and in place of the old conception of salts made up of bases and acids, we had that of a new series of radicals, oxynitrion and oxysulphion, the analogues of chlorine and iodine, forming acids with hydrogen. The excesses to which this doctrine of compound radicals was carried, however, provoked a reaction, and the unitary system of Laurent and Gerhardt arose, from which all notions of base and radical, or of oxide and acid were excluded. A chemical compound was regarded a unity, in which the conception of dualism found no place; a great advance in chemical theory. In such a compound, if a salt, the equivalent substitution of one metal for another involved no hypothesis, but was a simple statement of a fact, and from this notion to that of the substitution for an element of a group of elements (the so-called compound radicals), was but a step; so that by formulas constituted in accordance with the unitary system, it becomes possible to give an intelligible view of the constitution of bodies, which no dualistic formulas could represent. The doctrine of types, first enunciated by Dumas, advanced by Laurent, and perfected by the labors of others, may be said to be the basis of our present chemical theory. It was the conception of the dual water-type which first rendered clear the theory of ethers and anhydrous monobasic acids, and thence the generation of bibasic and tribasic acids, whose derivation from the water-type I taught as early as 1848, some years before these views were accepted by Williamson and Gerhardt, whose names are generally associated with this extentension of the original doctrine of Dumas. What I regard as a misconception of its use has been taught by some chemists, who imagine a double or triple water-type, in which, as in the case of the phosphoric acids, a divalent and a trivalent radical replace respectively two and three equivalents of hydrogen, thus giving rise to bibasic and tribasic acids. We have rather. I conceive, first a reaction between phosphoric pentoxide and water, giving rise to the monobasic acid, which in its turn reacts with a second equivalent of water to generate the bibasic acid, from which again the tribasic acid is produced by reaction with a third equivalent of water. Such is the natural process of the generation of these polybasic acids, while, as I have elsewhere endeavored to show, the extension of the other view to the so-called subsalts (which, as long since pointed out by Gerhardt, are truly neutral polybasic salts), forces us to admit, for certain basic sulphates and chlorids, polyatomic radicals which are mere algebraic expressions, containing negative quantities. The radical theory here fails, and our system of notation based upon it is found inadequate to represent all the cases of chemical operations.

A so-called rational formula is constructed with a view of rendering intelligible a certain class of reactions; while from other points of view other rational formulas are equally admissible. In all of these formulas we are striving to express the relations between a given body, on the one hand, and those from which it has been derived, or those into which it may be resolved, on the other, and the possibilities of generation are such that no one formula can adequately represent all the

changes observed. By the use of what are called dissected or structural formulas it becomes possible to include a wider range of transformations, but even here it is found that different reactions in some cases lead to different final dissections, as has been lately well pointed out by Wright, thus showing the inadequacy of these formulas also. These considerations led me in 1853 to insist that "the notion of pre-existing elements or groups of elements," should find no place in the theory of chemistry, and "that of the relation which subsists between the higher species and those derived from them we can only assert the possibility, and under proper conditions the certainty, of producing the one from the other." Of our rational formulas we may say, in the language of Gerhardt, that they "are not intended to represent the arrangement of the atoms, but to make evident in the simplest and most direct manner the relations which connect bodies with one another in their transformations." Thus understood, and with these reserves and limitations, they have an important place in chemical teaching.

The study of water in its relations to organic bodies soon showed that it must be regarded as containing two equivalents of hydrogen combined with a single proportion of oxygen, the weight of which was hence not eight, as it had previously been regarded, but sixteen, hydrogen being unity. From this bibasic or dual type of water flows the conception of the bivalency of oxygen. The doubling of the equivalent weight of carbon followed as a consequence, and the study of its compounds showed that this element, with an equivalent weight of twelve, was quadrivalent. Henceforth the different saturating powers of the elements became a recognized principle in chemical theory.

The increase by regular increments of carbon and hydrogen in the compounds of organic chemistry was a remarkable extension of the principle which underlies the theory of definite and multiple proportions. This condensation of matter appears alike in homologous series, and in polymeric compounds not homologous, and finds further illustrations in the polymerism of the elements, as shown in the different modifications of oxygen, phosphorus, and carbon; in which we find bodies of very unlike physical and physiological characters generated from the same elementary species, and sometimes carrying their modified condition into their combinations, as appears in the singular chemical relations of the graphon and graphitic acid of Brodie. In vapors the density varies as the equivalent weight, the volume being a constant quantity, and it would appear that, at least within certain limits and for species of related crystalline forms, this is true of solids. Were this true for all solid species, it is obvious that we should be enabled to find the relative equivalent weights of these modifications of phosphorus and carbon. By the comparison of these with substances known to possess a high equivalent weight, as, for example, some organic bodies, it would even be possible to fix that of these elemental species, which would certainly be found to have a very elevated equivalent, indicating a high degree of polymerism.

If now we extend this view to compound species like the natural silicates and carbonates, we shall find many evidences of a similar polymerism. The elevation of the equivalent shows itself not only in augmented density, but in increased hardness and greater chemical indifference. Examples of this are seen in silicates like meionite and zoisite, and also in carbonates like calcite, dolomite, and magnesite, to which I have been led to assign, provisionally, equivalent weights including not less than fifteen and twenty equivalents of carbon.

But apart from the polymeric condensation, which appears alike in elemental and in compound species outside of the domain of organic chemistry, we may also in mineral bodies find relations similar to those presented by the hydrocarbon series in which the first term is unlike the common difference, and we shall even recognize, in these, evidences of chemical homology, showing itself in similar crystalline form and in related physical properties. Examples of this are seen in many mineral species, which differ from each other in their varying proportions of water and protoxyd bases. The polymeric isomorphism of Scheerer here finds its place, and the relation seen in certain bodies of varying composition and constant crystalline form, which Cooke has designated allomerism, its natural explanation.

But while we thus increase our knowledge of the transformations of matter, and multiply compounds, while the marvellous methods of synthesis now enable us to build up from elemental carbon and hydrogen the most complex bodies of the carbon series, at will; while the method of diffusion through membranous septa is giving us a clearer conception of that delicate and subtle chemistry which works in the vegetable and animal organisms, there is a question lying behind and beyond all this which demands our attention, which is the essential nature and the mode of chemical operations. The phenomena of chemistry lie on a plane above those of physics, and, to my apprehension, the processes with which the latter science makes us acquainted can afford, at best, only imperfect analogies when applied to the explanation of chemical phenomena, to the elucidation of which they are wholly inadequate. In chemical change the uniting bodies come to occupy the same space at the same time, and the impenetrability of matter is seen to be no longer a fact, the volume of the combining masses is confounded, and all the physical and physiological characters which are our guides in the region of physics fail us, gravity alone excepted; the diamond dissolves in oxygen gas, and the identity of chlorine and of sodium are lost in that of sea-salt. To say that chemical union is, in its essence, identification, as Hegel has defined it, appears to me the simplest statement conceivable. The type of the chemical process is found in solution, from which it is possible, under changed physical conditions, to regenerate the original species. Can our science affirm more than this, and are we not going beyond the

limits of a sound philosophy when we endeavor, by hypotheses of hard particles with void spaces, of atoms and molecules, with bonds and links, to explain chemical affinities, and when we give a concrete form to our mechanical conceptions of the great laws of definite and multiple proportions to which the chemical process is subordinated? Let us not confound the image with the thing itself, until, in the language of Brodie, in the discussion of this very question, "we mistake the suggestions of fancy for the reality of nature, and we cease to distinguish between conjecture and fact." The atomic hypothesis, by the aid of which Dalton sought to explain his great generalizations, has done good service in chemistry, as the Newtonian theory of light did in optics, but is already losing its hold on many advanced thinkers in our science. Williamson admits that the conceptions involved in this hypothesis "are not raised in chemistry by any evidence whatever," and Wright, in a late essay, has done good service by defining its true relations to our modern notation; while Brodie, in his Calculus of Chemical Operations, has pointed out the way to a higher chemical philosophy.

THE CENTURY'S PROGRESS IN INDUSTRIAL CHEMISTRY.

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Chemistry was an art long before it was a science. But it was not until Priestley had discovered oxygen, and Lavoisier became the interpreter of chemistry with his great analytical mind, and the balance in his hand, did the daylight of chemistry truly dawn upon the world; previous to that time all was dim twilight, little better than darkness. When Lavoisier made the study of quantity an important element in chemistry, followed by Dalton's discovery of chemical proportions, then the inventive genius of mankind made chemistry a useful and certain servant, and built up one industry after another. As an art it has a pre-historic date; for whatever of the arts furnished products resulting from changes in the materials that nature furnished, and were produced by the reaction of one substance upon another, properly ranks as a chemical art; but it never began to assert its dignity as such until the sixteenth century, when that rude specimen of a scientific reformer, Paracelsus, undertook to deal with his contemporaries in a language more forcible than elegant, and in his violent denunciation of the medical men of his day he says:—

"After having studied Hippocrates, Galen, and Avienne, you think that you know everything, but you absolutely know nothing; you prescribe medicines, and you are ignorant of the method of preparing them! Chemistry it is that solves all problems of physiology, pathology, and therapeutics; outside of chemistry you only grope in the dark."

"Your Prince Galen is in hell; and if you knew what he had written to me from that place, you would make the sign of the cross with a fox's tail. Your Avienne is at the threshold of purgatory. O hypocrites! you will not listen to the voice of a physician instructed in the works of God; and after my death my disciples will expose your impositions, and show you to be but poisoners of Christian princes and gentlemen.

"Speak to me rather of chemists; they are not a lazy set such as you are, and are not clothed in velvet and silk, with rings on their fingers, and white gloves on their hands. They work night and day to get at their results; they do not frequent places of amusement, but pass all their time in the laboratory, and wear soiled clothes, are not afraid of burning and soiling their fingers with fire or filth; they are as black and sooty as blacksmiths and coal-heavers."

This was Paracelsus's theme, drunk or sober, and if history be correct, he was only sober when not in the first condition. In vigor and boldness he was a reformer of the type of his cotemporary Luther.

And from the age of Paracelsus, we may fairly date the epoch of that reform in the chemical art, which in the latter part of the eighteenth century culminated in the present *science of chemistry*, the result of hard labor and much self-denial.

All that is asked of me on this occasion is a review of a century's progress in industrial chemistry; to do this in an efficient manner, requires more time than is given to the celebration of this memorable occasion; to treat it otherwise, is but to give an imperfect enumeration of the wonderful applications of chemistry to those arts which have added so much to the prosperity, wealth, and well-being of the civilized world during the nineteenth century, which latter I must content myself with. In fact, industrial chemistry links itself with every modern art in such an intimate manner, that were we to take away the influence and results of chemistry, it would be almost like taking away the laws of gravitation from the universe. Industrial chaos would result in one case, as material chaos would in the latter. The miner, the metallurgist, the machinist, the weaver, the paper-maker, the painter, the glass-maker, the fine arts, all draw from the rich storehouse of chemistry. To these we must add the new arts born directly from the same source, viz., photography, galvanoplasty, gilding and silvering metals, dyeing with new colors obtained from coal, vulcanized India-rubber, stearine candles, sugar from starch and wood, etc.

No one can paint in too vivid colors the sum of the indebtedness the civilized world is already under to the chemist, and no enthusiast can transcend in his wildest speculations what we are yet to realize. The chemical arts in their strictest sense do not simply aid the other arts, but they keep in activity a vast amount of capital, and consequently give employment to a large number of individuals, skilled and unskilled. In France

* Much that is contained in this paper I have written at other times, when one or other of the subjects embraced had to be discussed by me. J. L. S.

alone, the annual value of chemical products is over $250.000.000, of which $125.000.000 represents the articles of sulphuric acid, soda, soap, India-rubber, and candles. Of chemical products, France exports $20.000.000 worth, the remainder being consumed at home in giving activity to other industries whose products are largely exported in the form of woollen, cotton, and silk stuffs, etc.

The above statement represents the activity of industrial chemistry in but one country, yet every part of the civilized world is more or less engaged in the manufacture of chemicals.

It is not an easy matter to decide in what order to review the details of its progress, whether chronological or otherwise. I have, however, thought it best to adhere more or less to the former, without binding myself strictly by it. So I will call your attention first to the industrial chemistry of oxygen and chlorine, both elements of 1774.

Oxygen.

Oxygen, we are well aware, was first formed from dissociation of the elements of oxide of mercury through the agency of heat, and from that time to this most of the processes for obtaining oxygen have this for their basis. There are no less than eleven methods of producing this gas practically.

1. By heating oxide of mercury—Priestley in 1774.
2. " " red oxide of lead.
3. " " nitrate of potash.
4. " " peroxide of manganese.
5. " " chlorate of potash.
6. " " sulphuric acid to a red heat. } St. Clair Deville and Daubray.
7. " " binoxide of baryta. }
8. " " oxychloride of copper.
9. " " manganate of soda in the presence of steam—perfected by Tessie du Motay.
10. By decomposing chromic acid with sulphuric acid.
11. " electrolysis.

But of all of these processes, only two or three of them may be said to belong to the domain of industrial chemistry, viz., heating chlorate of potash, sulphuric acid, oxychloride of copper, or manganate of soda.

For producing pure oxygen, the former is the one most commonly employed; for an impure oxygen, but costing much less, the latter method, by permanganate, is employed. There is one other development connected with oxygen during the past century: it is that of Schönbein, of giving to it a condition different to its ordinary one, approximating much nearer to chlorine than ordinary oxygen, and known under the name of ozone.

As yet oxygen in either of its conditions has received but limited application in the arts, but as the ready and economical method of producing it is of but recent origin, we must wait for the development of its industrial application. And my conviction is, that the day is not far distant when Priestley's name will not only be connected with the discovery of the corner-stone of modern chemistry, but will also be associated with one of the most useful agents in the chemical arts. Its most important application is to the fusion of platinum in conjunction with hydrogen or hydro-carbon gases, and within the past few months a large ingot of 500 pounds of the alloy of platinum and iridium (used for making the standard meter for the different European and American governments), was fused by its use; in fact, no other known method could have been applied to give the required uniformity to the above alloy.

Chlorine.

I now pass to chlorine, to which this celebration belongs almost as much as it does to oxygen, and none of us can hear the name of Priestley pronounced, without our associating it in our mind with that of Scheele. To chemical industry and to the development of some of the most useful arts, the importance of the discovery of chlorine cannot be overrated.

When Scheele first described it, he seems to have studied all its properties, and left nothing for future chemists to develop, under this head, except his misconception of its true chemical position; which, of course, in no way affected the results of his investigation with reference to its reactions. The one property, however, which makes it so important an article in chemical industry, is its power of destroying organic coloring matter, by what is by many supposed to be an indirect process of oxidation. Thus the two elements discovered by the two great contemporaries, Scheele and Priestley, interweave themselves in their useful effects.

The present advanced condition of the art of bleaching was not the growth of a day. The following is a short summary of its growth. Berthollet in 1785 observes that an aqueous solution of chlorine, which had been discovered by Scheele in 1774, possessed the power of destroying vegetable colors, in the same manner as the gas itself. Berthollet showed the process to Watt at Paris in 1786, and Watt on his return to Scotland tried the plan on 1500 yards of linen in the bleach-fields of his father-in-law near Glasgow. It was brought under the notice of the bleachers at Aberdeen by Professor Copeland, and was introduced at Manchester about the same time, chiefly through the labors of Dr. Henry. It was soon found that the texture of the goods was injured by the action of the chlorine, and that the workmen were much affected by the gas. Berthollet obviated these difficulties in a great measure by adding potash to the water, and Henry followed by substituting lime. About this period, the eminent manufacturer, Mr. Tennent, to whom we are indebted for the adaptation of this valuable agent to all the purposes of bleaching, took out his first patent for the manufacture of a saturated solution of chloride of lime, which he superseded by another patent, 1799, for the dry chloride of lime or *bleaching powder*, and this last we may regard as the greatest advancement since the discovery of chlorine, towards rendering it available in the arts, for it can now be transported readily to all parts of the world, and,

moreover, we are indebted to this form (so to speak) of chlorine for the discovery and manufacture of that great boon to suffering humanity, viz., chloroform.

As regards the manner of making chlorine, no process has been devised since that of Scheele that is more ready or more economical, viz., the reaction of black oxide of manganese on chlorhydric acid or its equivalent, a mixture of common salt and sulphuric acid. Various processes have been devised for oxidizing the chlorhydric acid by mixing its vapor with air, and passing it over red-hot surfaces, but as yet none of these processes are adopted.

Let us see what chlorine has accomplished in its industrial application during the past century. Commencing with the agriculturist, it has stimulated the growth of cotton, and I believe that I am within bounds when I say that $100,000,000 less of cotton would be made and sold in this country than is now the case, had chlorine not been discovered; a vast amount of the mineral wealth, in the shape of coal and iron, that has now enriched England for the past century, would have been still dormant in her mines, the buzz of the spindle, and the ceaseless racket of the loom, would have been far less than what it is; and why?

It is not sufficient simply to spin and weave cotton to make it useful for the purposes of comfort and luxury—the cotton fabric as it comes from the loom is but a dingy and unsightly stuff—it must first be rendered as white as the driven snow before it becomes fitted for many of its uses. This in former times, as is well known to us all, was done by the agency of the oxygen of the air, the stuff being spread out on the greensward, or hung on rails, and moistened with water, a process requiring days and months, and a large surface of territory.

Chlorine has revolutionized this, and a few hours accomplishes that which formerly required days; and a few hundred square feet, containing properly constructed vats, takes the place of thousands of acres of land. Thus the civilized world has been able to use four or fivefold the amount of cotton than it otherwise would have done, and millions upon millions of acres of territory saved to the cultivation of grain and other necessities of life.

Perhaps I do not exaggerate when I say that one-twentieth the cultivatable territory is saved in England through the agency of chlorine, on the assumption that it could manufacture cotton, to the amount that it does, without chlorine.

So then, all hail to the industrial power of *Scheele's chlorine*, by its reaction on water developing the *oxygen of Priestley*. If chlorine has done thus much in the past century, she has a host of assistants around her scattering their beneficient influences, although the principal one savors strongly of brimstone.

Sulphuric Acid.

I allude to sulphuric acid, which cannot be said to have been known for more than three or four hundred years; but the industry, as it now exists, belongs to this century.

The process of manufacturing this acid, by the combustion of sulphur, now employed, is an English invention, and dates back to the early part of the last century. The first great improvement in its manufacture, during the past hundred years, was made by Dr. Roebuck, of Birmingham, in 1786. It consisted in the substitution of leaden for earthenware vessels, and all subsequent improvements in apparatus have been based upon the increase of the size of the recipient vessels, and improvements in the apparatus for burning the sulphur, and the manner of applying the nitric acid to the sulphurous acid, until the lead vessels have become immense lead chambers, and the apparatus for burning the sulphur have become furnaces.

Improvements of a secondary character, but yet of very great importance, have been added to the above. The principal one of these is the substitution of iron pyrites FeS_2 for sulphur, and the other is the substitution of platinum for glass vessels in the concentration of the acid.

The first use of pyrites is claimed for two parties, Dr. Manson and Mr. Hill. While the use of iron pyrites in the manufacture of sulphuric acid dates back prior to 1830, it was not until 1838 that the short-sighted policy of the King of Naples, in granting the monopoly of Sicilian sulphur to Messrs. Faix & Co., of Marseilles, fairly established its use, for the price of sulphur rose in England from $25 to $70 a ton; and in twelve months from that time, in England alone, not less than fifteen patents were granted for the manufacture of sulphuric acid from pyrites.

And although the monopoly was soon withdrawn, by the persuasion of English vessels of war, and the diplomacy of other governments, the pyrites had secured a firm footing in supplanting sulphur in the manufacture of sulphuric acid; and since then its use has rapidly increased, giving a wholesome lesson to governments to exercise great caution in granting monopolies, and in legislating so as not to thwart industries based upon a science that draws brilliant dyestuffs from coal, and is not to be confined in the manner and methods of its creations, so long as the elements in one shape or another are at its command.

Since the first production of sulphuric acid from pyrites, the establishment of Fahlun, in Sweden, has employed this process altogether, pyrites being very abundant in that locality. This example was followed by Perret, of Chessey, France, where the pyrites contain from three to four per cent. of copper, which metal can only be extracted by desulphurizing the ore. From the mines of this locality seventy thousand tons of pyrites are used and exported annually, and the various lead chambers here for making sulphuric acid have a capacity of about 1,600,000 cubic feet. This process is carried on in all parts of France, whether the pyrites contain copper or not; and Sicilian sulphur is only employed for special purposes in France and England. I

would here remark that so perfectly can the pyrites be now burnt, that there need not remain over one per cent. of sulphur in the residue.

It is not to be supposed, however, that sulphur is henceforth to be excluded from the manufacture of sulphuric acid; on the contrary, it is more than probable that many factories will return to its use, as the sulphur in Sicily is almost exhaustless; and if ever the country becomes opened to the world by good and numerous roads, the price of sulphur must diminish, and the diminution required is very small to bring it again into more common use among the acid manufacturers of the world.

The factories in Belgium, in the north of France, and in some other parts of that country, those in Germany, and a number in England, will find it profitable in almost any state of the case to continue the use of pyrites.

As regards the concentration of the acid, the great cost of platinum vessels is a serious drawback in its manufacture, but we are none the less indebted to the use of these vessels for the cheapening of the acid. Glass can be used in some places advantageously.

Efforts are now being directed to perfect a method of concentrating in vacuum, by which lead vessels can be used; but, up to the present time, with only partial success. Döbereiner's suggestion of making sulphuric acid in very much smaller apparatus than that now used (by the agency of sulphurous acid, air, and spongy platinum), has been tried and worked successfully on a small scale, and its extended success belongs to the future of chemistry; the minor improvements, such as recovering the nitrous acid, etc., do not properly form a part of the review of the subject for such an occasion as this.

Bisulphide of Carbon.

Besides the use of sulphur for sulphuric acid in the chemical arts, it has of latter years been employed to no inconsiderable extent in making bisulphide of carbon, which is now manufactured on a very large scale, especially by the improved arrangement of apparatus of M. Deiss, placing a battery of four fire-clay cylinders, five feet high by twenty inches in diameter, into one furnace, and producing it at a cost of five cents per pound. Other forms of apparatus, however, are used to advantage. Some idea of the extent of its production may be inferred from the fact that several manufacturers make over a half ton each per day. It is used principally for dissolving and softening caoutchouc in the process of vulcanization; in the gutta-percha manufacture; in extracting bitumen from minerals by a process invented by M. Moussu; in extracting fat and oil from bones, oil cake, etc., sheep's wool, greasy refuse stuff, as cotton waste, etc.; also used for the extraction of the aromatic principles of spices and other odoriferous plants, and, when perfectly pure, it is said that it can be used for extracting the most delicate perfumes from plants and flowers, without injuring the odors. It has also served as an agent for producing motive power, owing to its low boiling point, and engines have been worked successfully by it. In fact, much may be expected of it from its extended use in the future.

Soda.

From sulphuric acid my subject naturally glides into the history of the Industrial Chemistry of Soda, and, in referring to its origin, I will use the words of Hofmann and Ward: "The ever memorable discovery, by the illustrious Le Blanc, of the process now everywhere in use for manufacturing carbonate of soda from common salt, stands distinguished in the annals of industry, not only as by far the most important of all chemico-industrial inventions, but also (a signal fact) of having been created perfect. All the other great chemical industries have been slowly worked out by the toil of successive inventors, but Le Blanc's process, the greatest of them all, remains to this day, what it was when he first gave it to the world, the best and simplest method of effecting the most valuable of all known transformations. Though eighty-six years have elapsed since this splendid discovery was made, and innumerable researches have been undertaken with a view to its improvement, the original indications of Le Blanc are all but universally followed, with merely a few comparatively unimportant modifications.

"It might have been expected that a process which, at its first introduction, was examined by a government commission of thoroughly practical men, and which, after having been submitted to comparative experiments, made with the greatest care, was recommended in an elaborate official report, would have been almost immediately adopted throughout Europe, with proportionate advantage to its discoverer. Such reasonable hopes, if entertained by Le Blanc, were destined to cruel disappointment. Le Blanc himself never reaped the reward of his admirable discovery.

"This man, who was certainly one of the greatest benefactors of his race, and to whom, long since, France and England should have joined to raise a statue, lived in poverty, and died in despair. The creator of incalculable wealth for his species, he wanted bread himself; and, after endowing man with cheap soda—that is, with the inestimable blessings of cheap glass and soap, cheap light and cleanliness, and a hundred collateral advantages—he was suffered, to the shame of Europe, to end his days in a hospital. There he lingered, a wreck in fortune, health, and hope, till reason herself gave way, and he perished madly by his own hand. It is to be hoped that with the advance of civilization these terrible tragedies, so frequent in past ages, will become more and more rare, till the future historians of progress shall be spared the pain and shame of recording any more such outrages on justice—such ghastly martyrdom of genius."

As the soda industry is the most gigantic chemical industry in its results upon the well-being of society, and the advancement of civilization, it is well to give a little history of it, as from its incipiency to its present state it belongs to the past hundred years, and, besides,

it is somewhat historic, too, in its relation upon the early recognition of the importance of the science of chemistry by great governments.

Early in the war of the French Revolution, France was cut off from her usual supply of soda, so requisite for many of its arts, as those of glass and soap-making, for at the time Spain supplied France with the soda she used, it being manufactured from the ashes of the sea-weed.

The French Convention at that time issued a proclamation, which went on to say: "Considering that the Republic ought to extend the energy of liberty to all of the objects which are useful in the arts of first necessity, free itself from all commercial dependence, and draw from its own sources all the materials deposited therein by nature, so as to render vain the efforts and the hatred of despots, and should place equally in requisition for the general service all industrial inventions and productions of the soil, it is commanded that all citizens who have commenced establishments, or who have obtained patents for the extraction of soda from common salt, shall make known to the Convention the locality of these establishments, the quantity of soda now supplied by them, the quantity they can hereafter supply, and the period at which the increased supply can be rendered."

In conjunction with the proclamation, a committee of four chemists was appointed in the first year of the French Republic to examine into all the processes devised for the purpose. The chemists were Lelievre, Pelletier, D'Arcet, and Giroud, and they made their report the following year, after having examined thirteen processes, six of these commencing with the formation of sulphate of soda from common salt; and here is what they say in their report:—

"Citizens Le Blanc, Dize, and Shee (copartners) were the first who submitted to us particulars of their processes; and this was done with a noble devotion to the public good. Their establishment had been formed some time previously at Trainciade, but the consequences of the French Revolution, and of the war which followed it, having deprived them of funds, the works were suspended, and for some months past the manufactory had become a national establishment.

"This establishment had been erected entirely with the private funds of the partners. It would be difficult to collect together, in so moderate a space, more means and conveniences than are met with in this manufactory—furnaces, mills, apparatus, and magazines, all arranged in the best order for the convenience of the service."

The report then gives a full description of all the various steps in the process that constitutes the invention of Le Blanc.

It is needless for me to detail how extended this soda industry has become, but will conclude this part of my subject by giving a chronology of the soda trade, as given by Gossage.

Chronology of the Soda Trade.

Period.	Raw material used, and prices.	Quantity manufactured.	Prices.
1790	Barrilla and kelp	Not known.	Not known.
1792	Le Blanc's process invented and applied in France	Not known.	Not known.
1814	Crystals of soda, made from Bleacher's residua, and by Mr. Losh from brine		Soda crystals $300 per ton.
1823 and 1824	Mr. Muspratt's works commenced using— Common salt at $ 4 per ton Sulphur at 40 " Lime at 4 " Coal at 2 "	Probably 100 tons per w'k of crystals & soda ash.	Soda crystals $90 per ton, Soda ash $120 per ton.
1861	Fifty works in operation in Great Britain using Le Blanc's process Raw material in Lancashire costing Common salt $ 2 00 per ton Sulphur from pyrites 20 00 " Limestone 2 00 " Fuel 1 50 "	5000 tons per week.	Soda crystals $22 per ton, Soda ash $40 per ton.
1861	Annual value of produce $10,000,000. Number of workmen employed in the manufactories 10,000, exclusive of those engaged in mining for pyrites, limestone, and coal; also those employed in navigation and other means of transport.		

The important bearing of the soda industry is the only excuse I have for so lengthy a reference to it, and I can only venture to touch upon two or three additional points in connection with it; the first is the recovery of the sulphur from what is known as the soda waste, thus making this agent to renew its function again and again in the production of soda. At present hundreds of tons of sulphur are recovered by processes well known to most chemists.

Another fact I must not omit is the employment of a large quantity of a mineral from Greenland called cryolite for the production of soda, and yet more recently the perfecting of what is known as the bicarbonate of ammonia process, by Salvay & Co., of Belgium, who in 1873 produced by this process 5000 tons of soda, employing 110 workmen.

Potash and its Salts.

Much of what has been said in relation to soda, is equally applicable to potash. This article, that was procured by the destruction of our forest, is now furnished in vast quantities and at a much lower rate from mineral resources.

The first one resorted to was the sea water, or rather the residual water after crystallizing out common salt for consumption in domestic economy and the arts. And one of the best methods of conducting the separation was devised by Balard, and is carried on to a considerable extent in France. But the great future source of potash is from the minerals sylvite, carnallite, kainite, and polyhalite, now discovered in great abundance in the salt mines of the Stassfurt, and other salt mines in the world.

The chemist converts the potash-chloride found in those minerals into the carbonate in the same manner as he makes the carbonate of soda from common salt.

Cyanide of Potassium.

This cheapening of potash of course gives new impetus to chemical industry dependent upon this alkali, among them the manufacture of cyanide of potassium, of which the most advanced chemistry is the manufacture of the cyanogen from its elements, although the practical application on a large scale still meets with considerable difficulty.

Oxalic Acid.

Another recent industry, sprung up from the application of potash in the caustic state, is the formation of oxalic acid by heating sawdust with it, there being usually employed with it a certain quantity of caustic soda, which latter alkali will not produce the required effect alone, although potash will, and the reason of the admixture with soda is to make the process more economical.

Soluble Silicates.

Cheap soda and potash have enabled the chemist to make on a commercial scale soluble glass. As an industry, it was started as early as 1825 by Fuchs, of Munich. But it has only been in latter years that its application has been extensive, and we are all now familiar with its use in hardening and preserving stone, preparing artificial stone, cement, etc.

Stearinery.

The next industry that demands our notice is that of stearinery and soap-making, and all that is important in connection with it belongs to the latter half of the past hundred years, and dates from the labors of Braconnot in 1817 in separating oleine and stearine, and were specially developed by the remarkable scientific researches of M. Chevreul.

That these labors deserve to be ranked so high, arises from the fact that they were made at the birth of organic chemistry, and on a most difficult class of bodies, about the nature of which there was no correct conception, and when the analysis of organic substances had been but just commenced. Still more, M. Chevreul did not give to the world the results of his labors as a mass of isolated facts, but he systematized and classified new acids, new bases, and left to us the chemical history of facts almost as fully made out as they are at the present time; and these have contributed as much, if not more than any class of researches to give direction and growth to organic chemistry. The decomposition of the fats and formation of the fatty acids developed the fact that, when melted and allowed to cool slowly, the more solid acids crystallized, so as to allow of easy separation of the solid from the liquid part, which fact soon suggested a practical application.

In 1823 a complete account of the labors of Chevreul was published; at this period fruitless efforts were made to manufacture stearic acid.

Importance of the Stearic Acid Industry.

It is difficult to render an exact account of the importance of the stearic acid industry; nevertheless it can be stated with certainty that the annual production for France is 50,000,000 of pounds, and approximately for the remainder of Europe is 200,000,000 pounds, and for America 20,000,000 pounds.

The largest candle factory in the world is that known as the Price Company, having its principal establishments at Liverpool and London, with a capital of $5,000,000. The great steps in the progress of this industry were first made by Gay-Lussac and Chevreul in 1825, who first thought of applying the fatty acids for illumination, forming them first by saponifying the fats by alkalies or the alkaline earths, decomposing by acid, and separating the solid and liquid acids by pressure.

It will be seen that this process is deduced directly from the theoretical researches of Chevreul, with the important exception in relation to saponifying under high pressure.

The process of Chevreul and Gay-Lussac was not considered at the time capable of being brought into practice in the arts from their using potash and soda, thus making the product a very expensive one.

Besides the above difficulty in the original development of stearic industry, another arose in the very commencement, viz., that when candles were made with the ordinary wick, they burnt very imperfectly, and the inventors above referred to devised wicks of peculiar description that answered the purpose more or less perfectly. But prior to them J. L. Cambaceres devised similar ones, and subsequently improved upon them, and finally settled upon the plaited wick now in common use in all stearic acid factories.

The next important step rendering the stearic acid industry a success, was also made by M. Cambaceres, viz., the separation of the oleic acid by powerful pressure, first on the mixed acids cold, and subsequently warmed; and he established a factory in Paris to carry out his process, but this soon failed, from the inferior nature of candle-stock produced, and the expense of its production, potash being employed by him as the agent for decomposing fats.

For several years this industry was abandoned, as being a difficult and unprofitable one, when in 1829, two young physicians, De Milly and Motard, took the subject up, and after two years of laborious and persistent study of it, accomplished the problem of the successful manufacture of candles from the fatty acids. It is only simple justice to say that the names of Chevreul and De Milly go side by side in this industry, and the first in his theoretical discoveries, and the latter in his ingenious and successful devices in the accomplishment of great practical results.

A second advance in this industry was the use of sulphuric acid to decompose the fats, which originated also with Chevreul and Gay-Lussac, but was not successfully carried out until combined with the distillation of the fatty acid after the decomposition—a method first executed by Dubrunfaut, and successfully carried out by Coley, Jones & Wilson, and subsequently perfected by Gwinne & Jones.

The next step made in stearinery was the decomposition of the fats by water. The conception of this method, in common with all the methods of saponification of fatty bodies, is to be referred back to the author of the discovery of the true nature of fats, M. Chevreul, for in his original researches he pointed out the perfect analogy between the fats and the compound ethers, the latter class of bodies being decomposed into their two constituents, in the presence of water heated in close vessels under pressure; a reasonable deduction from which was, that fats would undergo an analogous decomposition. This, however, was not undertaken at the time, but, by an accident about the time of Chevreul's researches, it was observed to take place by Faraday when his attention was drawn to some changes in oils used by Perkins in his curious steam engine that employed very hot water.

No attempt was then made to draw any practical results from these observations, and we find no further notice taken of the subject until early in the year 1854, by R. A. Tilghmann, of Philadelphia, when patents were taken out by him for decomposing fats mixed with water, and superheated in vessels of a certain description. The method of Tilghmann, as originally patented, was never introduced into practice; since then, with change in the manner of operating, and in the nature of the boiler, it has been successfully conducted in many factories.

In the latter part of the same year that Tilghmann's process was patented, M. Melsens, of Belgium, took out a patent very analogous, using fats mixed with water in the proportion of twenty to one hundred per cent. of the latter; the water might be acidulated with from one to ten per cent. of sulphuric acid, or the addition of salt would suffice; the whole was heated from 180° to 200° C., for several hours. The success of Melsens's process was immediate, and it was put into operation on a large scale in Antwerp, in vessels holding one ton of tallow, to which was added fifty per cent. of water, and in six hours the decomposition was complete at a temperature of 180° C. (ten atmospheres). The fatty acids thus made were of a very satisfactory quality, quite as much so as those obtained by other methods of saponification.

But I would here say that this method, by superheated water, is now supplanted by a mixed method of using one or two per cent. of lime with the superheated water, which addition facilitates and hastens the reaction in a manner not yet understood by chemists.

Glycerine.

This new art of stearinery assumed such dimensions, that the chemist sought to utilize all by-products connected with it. The oleic acid or red oil, as is well known, is used for various purposes, principally for forming soap.

The candle-makers at first allowed the glycerine produced, to run to waste. This sweet principle of the fat was first discovered by Scheele in 1873, and afterwards studied by Chevreul in 1819, and its true nature ascertained, as a triatomic alcohol of the radical glyceryle, now having a well-defined place in organic chemistry. But, like everything connected with the art of which we are speaking, some minds were directed to examining and purifying it, and when presented to the world abundantly in its pure form, some application was sought for it, and its use became extended day by day. The principal features connected with the improvement in its manufacture, relate to its distillation, and still later to its purification by crystallization by Sarg, and in 1871 he purified in this way twenty-five tons. As for its application it is more varied than that of any other substance springing from the chemical arts. It is used in wine-making, beer-making, confectionery, liquors, in cloth-making, in calico-making, in preparing leather so as to remain supple and durable, in the tobacco factory, for lubricating delicate machines and firearms, etc., preserving organic matter, filling gas meters to prevent the effect of cold, for making rollers for printing presses, in the art of perfumery, in medicines, etc.

Nitro-glycerine.

But of all the applications of glycerine, the most curious one is that of making an explosive compound for blasting rocks, etc., of which there are now not less than seventy or eighty tons consumed annually.

In 1847 an Italian chemist named Sobrero, working in the laboratory of Pelouze, discovered that the action of concentrated nitric acid or a mixture of nitric and sulphuric acid upon glycerine produced a peculiar oily liquid, having among other properties that of exploding when struck by a hard body, or when heated. At first it was only regarded as one of the many curious compounds that are born every day in the chemical laboratory. Any practical application was not thought of, for the glycerine then was too expensive a substance to enter into competition with other substances used in making explosive compounds. It was reserved for a Swedish chemist named Nobel to make an application of this oily compound called nitro-glycerine, and by improvement in the process of its manufacture, and the consequent impulse it gave to the separation and purification of glycerine, it is now a substance of every-day use by those engaged in mining and in large engineering works, requiring the removal of large bodies of rocks; and, notwithstanding it is an extremely dangerous substance to handle, and many lives and much property have been destroyed by it, contractors on large works say that they prefer using it to gunpowder, with all its attendant risks.

Gun-cotton.

Gun-cotton is another of those curious chemical triumphs of the past few years of chemistry. It was never imagined that this well-known and useful vegetable fibre called cotton, could be so easily converted into one of the most powerful explosive compounds known, and would serve as an article of offensive and defensive warfare. The first announcement of its dis-

covery was in 1845 by Prof. Schönbein, of Basle, and almost at the same time by Böttger, of Frankfort. Its powerful explosive nature was made very manifest early in the establishment of its industry, by two very disastrous explosions, one in 1847 in the gunpowder factory of Messrs. Hall Brothers, where they were making gun-cotton, and the other in July, 1848, where 3500 pounds of this substance exploded at Bouchet near Paris. These and other accidents so alarmed the public that its manufacture was suspended, especially as some of them appeared to arise from spontaneous decomposition of the gun-cotton. But as it is a part of the code of chemical ethics not to be frightened at anything, especially at a creature of its own creation, they went to work at once to discover causes and remedies, in which as usual they succeeded, so much so that at the present time a number of batteries of artillery in the Austrian service use gun-cotton. It is employed largely by the English government in their military service, under the efficient direction of Prof. Abel. It is also used for blasting in quarries.

The most recent development, however, in connection with it, is that it can be exploded efficiently when wet, by the aid of a fulminating fuse, which fact, if properly borne out by sufficient experience, will increase its value, in so far as it increases its safety of transportation, etc.

I must here refer to a curious property of gun-cotton, viz.: its solubility in ether, or a mixture of alcohol and ether, producing a solution called collodion, which is the menstruum used by photographers for placing the chemical materials on the surface of the glass to receive the action of the light in the preparation of what are known as negatives. It was first used for this purpose by an English photographer named Archer, although the collodion had been prepared some time before by Dr. Bigelow, of Boston, and used in the surgical treatment of wounded surfaces. The value of gun-cotton as a photographic agent cannot be overrated, when we remember the ramifications of this art in social life and scientific pursuits; in this latter direction it is especially valuable to the astronomer.

In strict justice I should class the art of photography as one of the chemical industries created during the past hundred years, for every step in its invention, application, and future development depends on chemistry; but we must be satisfied with a simple mention of it.

Chemical Industry of Coal.

I will not delay calling the attention of my audience to a chemical industry pre-eminently one of this century, and, curious enough, it does not owe its origin to either chemistry or to a chemist, yet in its developments some of the ablest chemical talent in the world has been and is still engaged. I allude to the chemical industry of coal.

It was started by two individuals of practical mind, Murdock in England and Le Bon in France, who sought to control the gaseous products emanating from burning coal in such manner as to be useful for illuminating purposes, and from the year 1800 to the present time it has been used successfully for that purpose, and all the large cities of Europe and America, and numerous small towns, give evidence every night of the universality of its use, dispensing comfort all around.

Its direct effect is to convert night into day, to make the short and obscure winter days equal to those of summer, giving more time to those occupied with in-door pursuits, and enabling them to conduct their labors with less fatigue to the eye and with more certainty of execution. In this aspect alone the immense wealth that has been added to the industrial arts is incalculable.

In its indirect effects, the use of coal-gas has benefited society by saving vast tracts of land for other agricultural purposes that would have to be devoted to the cultivation of plants furnishing oil and fatty matters, to be used for illumination, and, besides, there have been saved for other purposes hundreds of ships and thousands of seamen that would be required for the whale and other fisheries carried on simply for the purpose of procuring oily matter to be used for furnishing light.

Regarded as a luxury, its benefits are not to be despised, for it has cheapened many of them to such a degree that both rich and poor are equal participants of them. Our brilliantly lighted streets are evidence of this fact, so that the people traverse our cities with the same ease and security at night as in daytime. And here we may again allude to another fact in connection with the manufacture of coal-gas, namely, that the offensive residues which are the natural results of gas-making have been made to give rise to most important industrial pursuits, employing a large amount of capital and labor and accumulating much wealth.

But it has been left for the more recent developments of chemistry to extract from the residues of gas-making, by processes more or less indirect, beautiful crystallized compounds used in giving to silk, wool, and cotton colors that rival in brilliancy the hues of the rainbow; and this discovery in its turn reacts on the manufacturers of the various textile fabrics.

In the making of gas from coal three great residual products are formed, consisting of coke, ammoniacal liquor, and tar, the last two of which were cast away as refuse, but now, under the directing mind and skill of the chemist, they have been converted into most useful products, the ammonia being collected and condensed in such form as to be made serviceable for all purposes in the arts and agriculture, which latter industry now depends very much upon it in giving the requisite nitrogen elements to artificial manures.

But it is from the coal-tar that the chemists, during the past fifteen years, have reaped a harvest of wonderful chemical results; from it they have extracted not less than seven acids, fourteen alkaline substances, and ten neutral bodies, and with many of these they have wrought such wonderful metamorphoses that chemists themselves, accustomed though they be to strange transformations, are amazed at the results of their own investigations.

As much as we might desire, we have not time to dwell upon progressive discoveries that led to the first aniline color in 1856, by Hofmann and Perkins, and will only state that in the short period which has elapsed since then, the chemist does with the tar of gas-works what the rain drop does with white rays of the sun, viz., unfolds all the beautiful colors of the spectrum, red, orange, yellow, green, blue, indigo, and violet; first came the mauvine and rose aniline in 1856, then the aniline red in 1859, then the aniline blue in 1860, then the aniline green in 1863, after that the violets of methylic and ethylic rosaniline, and aniline black.

And now our beautiful dyes are no longer brought from the tropics and the Indies, but Europe sends to China, Japan, and the Indies dye-stuffs, and sends artisans to show to those nations how to apply those dyes; the moneyed value of the present product being about $10,000,000. Is this no triumph for the industrial chemistry of the nineteenth century? Nor have we arrived at the end of this matter of the chemical industry of coal. That most valuable substance, alizarine, the coloring principle of madder, had defied the chemist's skill to imitate and produce by artificial means. With the chemist, to accomplish it was only a matter of time, and about five years ago we had the first announcement of the production of alizarine from one of the coal-tar products (but little known and of no commercial value up to 1870). So rapidly has this branch of industry grown, that, during the last year there was put into commerce 1000 tons of artificial alizarine dye, with a standard of 10 per cent. of alizarine, worth upwards of four millions of dollars, one-half of which was produced in Germany. So that now the agriculturist engaged in madder cultivation is fearing the supplanting of madder altogether by this new chemical industry, which furnishes to-day nearly one-half the alizarine dyes.

Phosphorus and its Applications.

In phosphorus and its applications we have a chemistry of small things, but an industry of great magnitude. In the words of another, "Phosphorus is a singular instance of an article, discovered one or two centuries ago, which, until recently, possessed very little interest but to the professional chemist, and more rarely to the physician; but which, by an application dating back little more than thirty years, rapidly became an object of large manufacture, and is now, in the everywhere indispensable lucifer-match, carried not merely over the civilized world, but to every land which possesses any commercial intercourse.

"The Dutch chemists, who laboriously first drew it forth in minute quantities, and by a tedious process from urine, little thought that this substance, so distinguishable from its self-inflaming qualities, would, in after time, be manufactured by hundreds of tons, and be not only found in every household, but made the kindling spark of all hearths in every civilized country. One of the largest manufacturers of phosphorus, when he underwent training, only knew phosphorus by a small stick two inches long that was in the laboratory in which he studied. He now draws it out by machinery in a cord many miles in length, and sends it off by tons to all parts of the world." The improvements in the method of manufacture, and the amount of consumption, are best realized when you are told that upon the introduction of its use in the manufacture of lucifer-matches, its price in England was $20 per pound, while the price now does not exceed 75 cents to $1 per pound; this economy of production being brought about by improved chemical processes, and by operating upon cheap and accessible material. There now exists some twelve or fifteen large factories, one-half of them in Germany, from which most of the phosphorus used in this country is imported.

The quantity produced is not less than a half million of pounds, nearly the whole of which is consumed in the manufacture of matches, one-half the above quantity being consumed in Germany for that purpose. In the chemistry of phosphorus, the most remarkable triumph is that of Schrötter, about fifteen years ago, in producing what is called amorphous phosphorus, which is now well known to all chemists, and is used extensively in the art of match-making; this wonderful change in phosphorus being produced on a large scale, and its inflammability so altered as to allow of its being handled with impunity.

It is not volatile or subject to slow combustion, and does not poison the atmosphere in which the makers of matches are obliged to operate, and does not produce that peculiar and painful disease of the jaw, which ultimately produces caries of the bone, to such an extent, in some cases, as to necessitate the removal of a large proportion of the jaw; showing that the aim of chemistry is not only to increase and improve the materials for the use of society, but to present them in such form as not to injure the health.

Iodine and Bromine.

Of iodine and bromine I have but little to say, although both their discovery, and their chemical industry have been the growth of the past fifty or sixty years. This neglect does not arise from their lack of importance, for they both rank as articles of prime necessity in several of the most important arts, as well as important curative agents in disease. There has been much improvement in the art of extracting both iodine and bromine from their raw materials, and coal naphtha has become an important agent in facilitating the separation of the iodine, or rather in collecting the iodine once separated by chemical agency. Also the Peruvian nitre has now become an important source of this substance. As for bromine, its production is increasing every year both in this country and in Europe.

Sodium, Aluminium, and Magnesium.

While sodium, aluminium, and magnesium do not perform as yet very important functions in the arts, they are produced on no inconsiderable scale, and are conspicuous examples of how mere laboratory methods may be rapidly developed into industrial processes when di-

rected by the skill and ingenuity of able chemists. In this particular instance we are indebted to M. St. Clair Deville, than whom there is no more ingenious chemist in working out difficult problems in the metallurgy of the rarer metals.

The production of these metals in quantity has given new agents to the arts, and sodium amalgam is now well known in metallurgic operations on gold. Aluminium and aluminium bronze have found their use for many valuable purposes, and magnesium is much valued for signal and rocket purposes.

Medicines.

But of all the benefits derived from the growth of mere laboratory processes into grand manufactural operations, none can claim more than the art of medicine, for she has received her full share, as we all well know, and as is every day shown by the operation upon cargoes of Peruvian bark to extract that valuable medicine quinine, and the elimination of thousands of pounds of morphine from opium: and, still more recently, the unfolding of the hidden treasures of the chemist has brought to light chloroform and chloral, the earlier specimens of which he valued as gold or silver, while now they are thrown upon commerce by thousands of pounds, alleviating an untold amount of suffering: and these great blessings are afforded mankind as a free-will offering of the skill and industry of the chemist, for he invokes no patent laws to make money from these precious gifts of God, whose high priest he is in one sense, having been favored by the divine dispenser of all good to make known these things to man.

The review just given of the chemical industry of the past hundred years, is but a notice of the salient points in connection with its history and progress. No mention is made of the art in connection with the working of iron, copper, and other metals, for that now takes rank almost as an independent art, called metallurgy, but it is none the less chemical in its character, and, as chemistry progresses, so will this art. The same may be said in regard to glass-making, photography, electrotyping and gilding, and numerous other arts which must have presented themselves to your minds during this discourse.

But I must not detain you longer, and shall conclude by congratulating you that we are living in an age in which an industry requires but a few years for its creation or development.

"In our days a useful discovery is scarcely made, or a happy application of one found out, before it is published, described in the scientific journals, or other technical periodicals, and especially in the specifications of patents. It then becomes the starting-point of a thousand researches and new experiments, entered into by the philosopher in the hope of advancing scientific progress, and by the manufacturer with the expectation of reaping a material benefit. From these multiplied and diverse efforts—these incessant labors of an army of workers—arises an industry which has no sooner sprung into existence than it becomes important and prosperous."

So then let us, American chemists, bend all our energies to do full share of this work. Up to the present epoch our short existence as a nation, and some other causes, have forced us to be the recipients of the numerous discoveries of our European co-laborers without an adequate return on our part; but there will be no such excuse for the future if we do not stand side by side with them in the developments of industrial chemistry.

AMERICAN CONTRIBUTIONS TO CHEMISTRY.*

BY BENJAMIN SILLIMAN,

Of Yale College.

ADDRESS.

Introduction.—The history of modern chemistry, commencing with Priestley's immortal discovery of oxygen, or dephlogisticated air as he called it, on the 1st of August, 1774, by a memorable coincidence is almost identical in date with the evolution of the United States of America out of their colonial pupilage by the declaration of their independence of the mother country. The emancipation of our science from the dominion of phlogiston, with its seductive but false philosophy, may be likened to the overthrow of aristocratic traditions, and monarchical supremacy, under which our ancestors were held, and the building up of the American system of self-government in their place. We note with satisfaction that the scientific revolution was a little in advance of the political revolution; and it would not be a difficult task to show, were it pertinent to our present purpose to do so, how closely and logically the rapid march of human society, the world over, during the century whose close we celebrate to-day, has kept pace with and waited upon the advance of the pioneers of scientific discovery. How Franklin and Black, Rumford and Cavendish, Priestley and Lavoisier, Galvani and Volta, Scheele and Berzelius, Dalton and Davy, Ampère and Faraday, Hare and Henry, Oersted and the Herschels, Liebig, Agassiz, and a multitude more of the noble army of martyrs to science, who have devoted their lives to the search for truth for the truth's sake, have, by the discovery and elucidation of principles before unknown or but dimly discerned, opened the way for the yet greater army of inventors and projectors, who have followed in their lead; with steam engines, railways, steamships, mechanical spinning and weaving, voltaic casting of metals, bleaching and other chemical arts without number, electric telegraphs, illumination by gas, photography, improved agriculture, artificial heat and artificial cold; using and applying in endless forms for human advancement, the public wealth, and private enjoyment the labors of those who have toiled to reveal the hidden truths of God in nature, too often unrequited for their self-sacrificing devotion in the good things of this world, but content to work that others might enter into their labors.

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* In attempting to comply with the invitation of the committee in charge of the Chemical Centennial at Northumberland, to prepare an "Essay upon American Contributions to Chemistry" as an address to be delivered on that occasion, I found the "Essay" insensibly and almost unavoidably assuming the historical form, and taking a wider range than may seem consistent with a strict rendering of its title. But such as it became it is now presented as a slight contribution toward a more elaborate historical discourse which yet remains to be prepared. B. S.

Among the greatest discoveries of modern times, comparable to the discovery of the law of gravitation itself in the previous century, was the discovery of oxygen by Priestley, August 1, 1774, which we are here to honor this day. What Newton's discovery did for celestial mechanics, in bringing order out of confusion, and co-ordinating things before beyond our reach, has Priestley's discovery done for the former chaotic confusion of facts in chemistry inherited from alchemy and the iatro-chemists, but impotent to explain the constitution of the universe of matter, for the want of the philosophy to which a knowledge of oxygen was the key.

In attempting to review the contributions to our science at the hands of American investigators during the century we celebrate to-day, it is proper in bar of criticism to say that I was called at a very late hour to the task in hand, and have become more sensible as the work opened before me of the disproportion between the brief time at command and the extent of the task assigned me. If important omissions are detected—and that there are such can hardly be doubted—the speaker must beg of his fellow workers in the common field some indulgence, as is due to human frailty; and while he is conscious of a desire to do full justice to the labors of all, he has also the knowledge that all among living laborers have not responded to his call for co-operation.

If an apparently undue proportion of space has been given to some portions of the historical part of our essay, it may be said in fairness that it is far easier and more just to write history than to anticipate it, and we who live in this latter end of the first century of modern chemistry must see to it that we leave such footprints in the sands of our time, that the future historian of the science cannot fail to do us justice.

In considering the contributions to chemistry made in the United States, the subject naturally divides itself under two subdivisions—the historical and the contemporaneous contributions.

Under the first division we may consider very briefly the scientific societies, public seminaries of learning, and channels of communication which were open to the investigators and students of science during the latter part of the last and the commencement of the present century. In doing this it will be convenient and in order to consider to some extent the work done in those times of which records exist. If some of it seems to us not very important, we must remember that such was then the case the world over, with a few brilliant exceptions, and of such exceptions I think it will appear that we have our full share.

Learned Societies.—Of societies devoted to scientific purposes, and which have left us any published memoirs or transactions, we find very few prior to the close of the last century.

In New England there was "The American Academy of Arts and Sciences," at Boston, instituted in 1780. "The Connecticut Academy of Arts and Sciences," established at New Haven in 1799, and, oldest of all, we find in Philadelphia "The American Philosophical Society," established by Benjamin Franklin in 1743, and recognized by provincial charter in 1769. This completes the brief list of learned societies instituted prior to the close of the last century which have published anything. The Literary and Philosophical Society of New York, which published a single volume in the early part of this century, had but a brief existence, and its volume of memoirs contains only one paper on chemistry.

Some of the Men Prominent in Early Scientific History in the United States.—In the history of science during the latter half of the last century we find prominent the names of Franklin, Rumford, and Priestley; the first two Americans by birth and education, the latter by sympathy and adoption. In the evening of his peaceful and philosophic life Priestley was a refugee from a strange intolerance and persecution which has left a stain upon the good name of England.

FRANKLIN was the founder of the American Philosophical Society in 1743, the oldest of all the scientific societies of America; he was also the originator of the University of Pennsylvania, and of the Public Library in Philadelphia. He was the president of the Philosophical Society after its charter in 1769 until his death in 1790. His own scientific researches were chiefly physical, and his labors as an investigator had mainly ceased prior to the dawn of our chemical century. But his tastes and well-grounded love of all knowledge and of all investigation into the laws of nature, made him to the last a devoted student and the zealous patron of all departments of science. He died just before Priestley's arrival in America, but in London, many years before, they had been associated in electrical investigations, and Priestley's History of Electricity was undertaken by the advice of Franklin, to whom the manuscript was submitted for criticism.

RUMFORD, whose scientific reputation is sure to grow with the passage of time, as it has done indeed constantly since his death, after imbibing from Dr. Williams, his instructor, a love for mathematics and the exact sciences, while yet a boy; and from the lectures of Dr. Winthrop, at Harvard, his early love for physical and chemical research was, by the force of circumstances over which he had no control, in a sense expatriated and forced into a position of disloyalty to the Republican cause. His life reads like a romance. We find him, after a term of service as a British officer, passing into the position of confidential adviser of the King of Bavaria, and in full charge of matters military, administrative, and philanthropic, with a field of usefulness and a rôle of honor seldom awarded to a humble born citizen of a foreign land. Yet amid all his great official cares and preoccupations, and his honors, social, military, and political, he was ever loyal to scientific research; embracing every occasion to glean new facts in the experience of daily life even when most oppressed with heavy public duties. This is everywhere evident in his memoirs. Thus, in the opening paragraph of the memoir which is undoubtedly on the whole his most important contribution to molecular physics, the research which first established on experimental grounds the relations of heat to motion,* he says, in his opening address to the Royal Society, in whose Transactions this remarkable paper first appeared: "It frequently happens that in the ordinary affairs and occupations of life, opportunities present themselves of contemplating some of the most curious operations of nature. * * * I have frequently made this observation, and am persuaded that a habit of keeping the eyes open to everything that is going on in the ordinary business of life has often led, as it were by accident in the playful excursions of the imagination, put into action by contemplating the most common appearances, to useful doubts and sensible schemes for investigation and improvement, than all the more intense meditations of philosophers in the hours expressly set apart for study."

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* An Enquiry Concerning the Source of Heat which is Excited by Friction. Complete works, I. p. 471. Am. Academy edition.

We claim Rumford as an American, and we look with the greatest satisfaction upon his scientific career and upon the character of his work, which in its method and expression is a model of elegance which will ever render his writings a classic in the literature of science. Let any young student who wishes to learn how physical and chemical truths are evolved by inductive research take up the study of almost any one of Rumford's memoirs—for example, that upon "the propagation of heat in fluids," in which, among other important data, the maximum density of water was first determined and the law of its unequal movements under equal variations of temperature first fixed by experiment—and he will find with what largeness of grasp and accuracy of detail the mind of this master marches upon the area of the unknown to take captive the facts of observation and marshal them in order to science. No writer of his time has left a nobler record of original power in physical science than Rumford. None in his time and for succeeding times has done more, and so well, to solve some of the toughest problems of social science than he.

Joseph Priestley's name is immortal in the annals of our century of chemistry. We are proud to claim him as an American by adoption, and are quite willing to adopt with him all his discoveries. A distinguished French Academician of this century once said, on presenting for the first time to the Academy of Sciences in Paris a memoir on the Law of Ohm, respecting electric conduction (long before accepted and familiar in Germany, but then first made known in France), "Truly, Mr. President, this is not a French discovery, but it is worthy to be made such!" So say we of Priestley and the discovery of oxygen: if it was not an American discovery, it is worthy to be made such. Whom England cast out with obloquy, we accepted with cordial hospitality. His heinous sins of republican ideas and hostility to an established church became virtues here, while his pure and blameless life, devoted during his later years, as in all his earlier career, to the cause of humanity and all truth, is his best defence against the charge of heresy which served as one poor factor in the indictment under which his house was destroyed by a mob, his apparatus, manuscripts, and library, the fruits of diligent years of research, consumed and scattered in the disgraceful riot at Birmingham in 1791, while he and his family fled for life to safer retreats. It is not part of my duty, agreeable as it might otherwise be, to draw the life and memorialize the scientific discoveries of Priestley. On this occasion that pleasing task falls to other and abler hands.

After his removal to the United States Dr. Priestley, re-established in the philosophic repose of his delightful home, here on the banks of the Susquehanna, again resumed his scientific studies. Here he completed his discovery of carbonous oxide, and here he composed his later papers which are recorded in the early volumes of the American Philosophical Society's Transactions; and in Dr. Mitchill's Medical Repository. These contributions were largely devoted to sustaining the phlogistic theory, of which he remained to the last an ardent defender, notwithstanding his own researches, and especially the discovery of oxygen, had supplied the weapons with which the antiphlogistians triumphed. There are few more remarkable examples than his in the range of philosophy, of the power of a grand idea to maintain itself against the inevitable logic of facts—of the subtle power of a plausible but untenable hypothesis to lead captive the imagination and pervert the reasoning powers. Even the absurdity of taking refuge behind an assumed principle of *specific levity*, to which the disciples of Stahl were driven to avoid the unquestionable testimony of experiment, seemed not to stagger the faith of Priestley, who has shown himself the master of a powerful logic when dealing in the polemics of statesmanship and the church. But while we may wonder almost if the defender of phlogiston at Northumberland can be the same man who is the author of some of the most remarkable researches in chemistry in his time, we cannot but admire the charming spirit in which he conducted his controversies with Woodhouse, Green, McNevin, and Dr. Mitchill, a controversy which, begun as strangers personally, led to a warm and lasting friendship, especially with the latter chemist.

In his paper, read December 20, 1799, before the Philosophical Society at Philadelphia, entitled "Experiments on the change of place in different forms of air through several interposing substances," he recognizes distinctly, for the first time, the phenomena of gaseous diffusion, and demonstrates the facts by original and ingenious experiments. He did not, however, carry the research far enough to reach the *law* governing the phenomena, a generalization reserved for Graham in our time.

We have quoted from one of Prof. Dove's lectures the anecdote illustrating the spirit of the French Academician in his willingness to gallicize a German discovery. We all remember the recent controversy excited by the opening sentence in Ad. Wurtz's *Discours Préliminaire* prefixed to his Dictionary of Chemistry (1868): "*La chimie est une science française.*" While with certain qualifications it is true that modern chemistry has its starting-point with Lavoisier and his colleagues, still we cannot fail to recognize in this sweeping declaration the same spirit of appropriation, nor wonder at the animosity it excited in Kolbe and other German and English writers.

Early Scientific Foundations.—Of foundations for exclusively scientific purposes made in the latter part of the last century, we enumerate but four:—

1. That of Rumford to the American Academy in Boston.
2. The foundation of the Rumford Professorship out of the residue of Rumford's estate at Cambridge.
3. The Magellan foundation, given to the American Philosophical Society in Philadelphia.
4. The Erving Chemical Foundation at Cambridge.

In the year 1796, Benjamin Thompson, Count Rumford, made to the American Academy, at Boston, a donation of five thousand dollars three per cent. stock in the funds of the United States, the income of which was for the award of two medals every second year for original researches and a published memoir in any part of America, upon heat and light. (*Memoirs Am. Acad.*, II., 141, 1804.)

The history of this foundation is recorded in Dr. Ellis's charming Memoir of Rumford, lately published by the American Academy, pp. 250–268. It appears that the Academy, in discharge of its trust, caused, in 1799, advertisements to be published in all the principal cities of the United States, giving notice that they were prepared to award this honorable distinction to any worthy claimant who might be entitled to receive it. But it was not until the year 1839 that an occasion was found which was deemed by the Academy worthy of this honor; and it must ever be a source of just pride to the chemists of America, that in the year mentioned the Academy gave from the interest of the Rumford fund

the sum of six hundred dollars to Dr. ROBERT HARE, of Philadelphia, in consideration of his invention of the compound blowpipe, and his improvements in the voltaic pile.

It may seem to some rather surprising that the Academy did not make the award to RUMFORD himself, in his lifetime, for his various discoveries respecting light and heat. They were probably restrained from doing so by a scrupulous regard for the literal terms of the trust; seeing, while Rumford was an American, he was not, during the time of his principal researches, resident in "any part of the continent of America."

This consideration need not restrain us, however, from doing honor to the American who demonstrated that heat was a mode of motion, more than a generation before the time of the modern philosophers to whom this discovery is often awarded.

In 1870 the Rumford Medal Fund had accumulated to upwards of thirty-seven thousand dollars, and by a decree of the Supreme Court, made under authority of the Massachusetts Legislature, the Academy was authorized to award Rumford medals annually; to add to such award a pecuniary grant for scientific work, not more than three hundred dollars in any one year, and to expend such further sums as in their discretion may seem best calculated to facilitate the making of discoveries and improvements which may merit the premiums to be by them awarded, etc. (*Life of Rumford*, p. 266.)

The "Life of Rumford" and "The Complete Works of Rumford," published by the American Academy of Arts and Sciences, now in progress, will probably fill five or six 8vo. volumes, of which Dr. Ellis's Life of Rumford is one. This and three volumes of the "Complete Works" are already published by the Academy. No American, since "Franklin's Life and Works" were printed, has received a more enduring scientific commemoration than this.

THE ERVING FOUNDATION of £1000, in 1791, for the endowment of the chemical chair in Harvard University, was, I believe, the earliest foundation of its kind in America. It is further noticed under the name of Aaron Dexter.

THE RUMFORD PROFESSORSHIP at Harvard was, by the will of Rumford, declared to be founded "to teach by regular courses of academical and public lectures, accompanied by proper experiments, the utility of the physical and mathematical sciences, for the improvement of the useful arts, and for the extension of the industry, prosperity, happiness, and well-being of society." The "Rumford Fund" for this professorship amounted, in the books of the college treasurer in 1870, to $52,848. On this foundation, there have been four appointments, viz.:—

Dr. Jacob Bigelow,	from	1816 to 1827.
Prof. Daniel Treadwell,	"	1834 to 1845.
Prof. Eben N. Horsford,	"	1847 to 1863.
D. Wolcott Gibbs,	"	1863 to 1874.

While chemistry was not a subject specified in the will of Rumford, it was so plainly congenial to his purposes, that the Rumford professor was in charge of the chemical work of the Lawrence Scientific School from 1847 until, quite recently, its incumbent, under the new *regime* at Harvard, has been remanded to the specific work of the foundation, and the chemical work has been placed under the direction of the Erving chemical chair.

The Rumford foundation has contributed to our American scientific literature, aside from the separate memoirs of its distinguished incumbents, some of which will have our attention hereafter among our chemical contributions, a volume entitled "Elements of Technology" (Boston, 1829), containing the lectures of Dr. Bigelow, delivered during his ten years of service on that foundation.

THE MAGELLAN FUND.—In January, 1786, Mr. J. H. de Magellan, of London (not to be confounded with the navigator Magalhaens, b. 1474, d. 1521, and after whom the Magellan Straits are named), gave to the American Philosophical Society the sum of two hundred guineas, to be vested in a permanent fund, the income of which was to awarded in medals of gold, with a specific inscription, in reward for original observations "in navigation or natural philosophy, mere natural history alone excepted." I have not found any award of this medal for researches in chemistry.

These are all the foundations of which I have observed any notice, for the encouragement of chemical and physical research, prior to the close of the eighteenth century, in this country.

Chemistry in America prior to the Commencement of the present Century.—Of public seminaries of learning, other than medical institutions, where chemistry was taught from a separate chair, and as a distinct branch of the college curriculum of instruction, prior to A. D. 1800, we find but one, and this distinction belongs to Nassau Hall, in Princeton, N. J. On the 1st of October, 1795, the day after the annual commencement in that year, the trustees of that institution elected Dr. JOHN MACLEAN Professor of Chemistry. He was a young chemist of Scotland, fresh from the instruction of Black and Hope and of the French School. But it is only just to add that Dr. Maclean, on the death of his colleague in the Chair of Mathematics and Natural Philosophy, assumed these duties in addition to those of chemistry. Dr. Maclean ever deserves honorable mention as one of the earliest and most successful teachers of our science in this country. Prof. Silliman in his reminiscences gratefully recognizes his obligations to Dr. Maclean and to Princeton. He says (vol. 1, p. 100, Fisher's Life), "I regard him as my earliest master in chemistry, and Princeton as my first starting-point in that pursuit." Dr. Maclean in 1812 accepted the chemical chair in William and Mary College in Virginia. In Paris Dr. Maclean had learned to admire the antiphlogistic theory, as the "new chemistry" of Lavoisier was then called, and which he taught and defended at Princeton.

In 1797 he published "Two Lectures on Combustion, supplementary to a Course of Lectures on Chemistry; read at Nassau Hall, containing an examination of Dr. Priestley's considerations on the Doctrine of Phlogiston and the Decomposition of Water." These lectures display both ability and learning, and form an interesting chapter in the history of the phlogistic discussion.

Dr. Maclean contributed several articles to the *N. Y. Medical Repository*, and his name is associated with that of Prof. Silliman in editing the first American edition of Henry's Chemistry in 1808.

Lectures on chemistry were given in connection with the Chairs of Physics or Natural Philosophy, and in the medical departments of several colleges at an earlier date than at Princeton.

At William and Mary the Right Rev. James Madison was Professor of Chemistry and Natural Philosophy as early as 1774.

At the University of Pennsylvania we find Dr. John

Ewing filling the Chair of Natural Philosophy and Chemistry from 1779 to 1801.

At Yale a chemical chair was instituted in 1798, but no professor was appointed until 1803.

At Columbia it was resolved in 1800 that chemical instruction should be separately given as a condition for the bachelor's degree, but no professor was appointed until 1802.

In the other academic colleges we find that chemical instruction was commenced at Bowdoin in 1805 by Parker Cleaveland, who held the office to 1858; in South Carolina College in 1811; in Dickinson College in 1811, and at Brown University in the same year; at Dartmouth in 1820; in Rutgers in 1830, and in Williams in 1830.

In the medical colleges we find chemistry early recognized as a branch of the curriculum of medical study, but at first in connection with materia medica. Thus in—

The University of Pennsylvania	in 1768.
King's (Columbia) College	" 1767.
Harvard College, Mass.,	" 1782.
Dartmouth College, N H.,	" 1798.
College of Medicine, Md.,	" 1808.

What kind of chemistry it was which was taught prior to the discovery of oxygen, it is easy to understand, and yet we must not suffer ourselves to undervalue the knowledge of those days. But of one thing we may be sure—we shall find little to detain us in examining the contributions to chemistry made in those early times. A few names of chemists stand out in bold relief on that distant background, but we find on examining the record that they shine rather by the brightness of their performances in other departments of knowledge than in chemistry. This is true of that eminent man, Dr. John Winthrop of Harvard, already named. Of the chemical work of his successors, Williams and Webber, if they did any, we have no record, and the same is true of Aaron Dexter, Prof. of Chemistry and Materia Medica at Cambridge from 1783 to 1806. But of the eminent abilities of John Gorham, who succeeded Dexter, we shall speak among the men of this century.

So in Philadelphia we find that eminent man, Dr. Benjamin Rush, elected to the chemical chair in the University of Pennsylvania, August 1, 1769, but we discover no record of his chemical work. He had been a student at Edinburgh, under the instruction of Dr. Joseph Black, and was an able expositor of the doctrines taught by the renowned Scotch teacher to whom belongs the honor of inaugurating the quantitative methods in chemistry, first set forth in his research into the difference between the so-called mild and caustic alkalies, in his well-known essay "De Magnesia Alba," in which he distinctly recognizes the function of carbonic acid, under the name of "fixed air." Dr. Rush was undoubtedly the first professor of chemistry in America, and as such his name must ever be entertained with respect, while he owes his well-earned reputation to his labors in other departments.

Dr. James Hutchinson, who succeeded Dr. Rush, had finished his studies in London, under the renowned Dr. John Fothergill, and that he had attained notable proficiency in the science of chemistry we must believe, from the fact that in the year 1774, the trustees of the Philadelphia College presented him with a gold medal "for his superior knowledge in chemistry," inscribed "Jacobus Hutchinson, 1774," and on the reverse, "Naturæ Artisque Arcana Retexi." After his death in 1793, the chair of chemistry was filled by the appointment of Dr. James Woodhouse, of whom more particular mention is made below.

I have been unable to find any original contributions by Dr. Hutchinson to our science. He lived amid the troubles of the American Revolution, and took an active part in the direction and organization of the medical department of the army under Washington, as well as in the local politics of Pennsylvania.

James Woodhouse was the Professor of Chemistry in the medical department of the University of Pennsylvania from 1795 to his death in 1809, succeeding Dr. Hutchinson; Dr. Priestley having declined the chair, to which he had been unanimously elected. Dr. Woodhouse was a frequent contributor to the *Medical Repository* of Dr. Mitchill, the *Medical Museum* of Dr. Coxe, and the American Philosophical Society, but his original investigations were few. His paper in answer to Dr. Priestley's arguments on the doctrine of phlogiston, which will be found in the *Am. Phil. Trans.* for 1794, p. 452, was sustained by well-devised experiments. He also, while in England in 1802, communicated to *Nicholson's Journal* (vol. ii.), "Experiments and observations on the vegetation of plants, to show that the common opinion of the amelioration of the atmosphere by vegetation in solar light is ill-founded." This paper was reproduced in the *Ann. de Ch. et Phys.*, xliii. 1802, p. 194, and in the same journal he published "An account of an experiment in which potash calcined with charcoal took fire on the addition of water, and ammoniacal gas was produced" (*Nicholson's Journal*, xxi. 1808, pp. 290, 291). He was, I think, the first to demonstrate, by several comparative experiments, "the superiority of the anthracite coal from the River Lehigh, in Northampton County, Pennsylvania, over the bituminous coals of Virginia, for intensity and regularity of heating power," an interesting historical fact.

Dr. Woodhouse in 1807 edited an edition of *Cheptal's Elements of Chemistry*, in two volumes, with many notes and additions, besides editing an edition of *Parkinson's Chemical Pocket Book*, 1802, with an appendix containing the principal objections to the phlogistic theory of chemistry, and a plate of his working laboratory. Professor Silliman attended the lectures of Dr. Woodhouse in 1802–3, and has drawn his portrait in his personal reminiscences. (See *Life of Silliman*, by Fisher, 1865, i. 100.)

Aaron Dexter, Professor of Chemistry and Materia Medica at Harvard College for thirty-eight years, from 1783 to 1816, was neither a man of research nor a successful teacher, if we may trust the memories of some of his pupils, who still survive, but we owe him thanks in that his influence (says Quincy, in his History of Harvard University) probably availed to induce Major William Erving to endow the chemical chair in Harvard College by a bequest of one thousand pounds in 1791, which chair has since been called after the founder.

In New York, where the learned Dr. Samuel Bard early instituted a medical school, which was united with King's (now Columbia) College, and which conferred its first medical degrees in 1769, we find but little to require our notice in chemistry prior to the appointment of Dr. Samuel Latham Mitchill, who was elected in 1792 "Professor of Chemistry and Natural History," in Columbia College. Few names in the early annals of American science are more worthy of our respectful regard than that of Dr. Mitchill. He was the first pro-

fessor of chemistry in the United States who introduced a knowledge of the Lavoisierian nomenclature, preceding Dr. Maclean in this by two years. Very soon after his appointment we find him in 1794 publishing an essay on the "Nomenclature of the New Chemistry," and involved in a friendly controversy with Dr. Priestley on phlogiston, to which allusion has already been made. In 1797 he published in *Nicholson's Journal* (i. 481–487) "An attempt to accommodate the disputes among the chemists concerning phlogiston." Dr. Mitchill was a man of wide grasp and varied learning, keenly alive to the importance of all knowledge, and an earnest worker in many lines of research. He established in 1798 the *New York Medical Repository*, etc., the first journal which was devoted to general as well as medical science in the United States. In 1796 he made "A mineralogical exploration of the banks of the Hudson River," which was the earliest attempt in America in this line of research, and in 1804 he published in the *New York Medical Reporter* "A sketch of the mineralogical history of the State of New York." In 1809 he also published in *Tilloch's Magazine* (xxxiv. 125) a "Discourse on Mineralogy." Of chemical papers he published, besides many minor notices in his own journal, in *Tilloch's Magazine*, in 1800, "On the non-action of nitric acid on silver, copper, and tin" (vii. pp. 83–85), and again in *Tilloch* (xx. 1800, 97), he communicates "Some interesting particulars on the history of the muriate of soda." In 1802 he presented a memoir to the American Philosophical Society, entitled "Observations on soda, magnesia, and lime, in the water of the ocean, and how the water of the ocean may be rendered fit for washing without the aid of soap." (*Trans.*, v. pp. 139–147.) In 1801 Dr. Mitchill published his "Synopsis of Chemical Nomenclature and Arrangement."

While Dr. Mitchell's chief contributions to science were in zoölogy and general science, we see by this sketch that he was one of the earliest contributors to our chemical literature, and the first author in the United States, whose name appears in the list of writers upon chemical philosophy.

Of journals and periodicals devoted to science in the last and the early part of the present century, there were very few or none, aside from the Transactions before referred to, in which science, properly so called, found any recognition, and such as there were were generally medical journals prior to the end of the last century.

The Medical Repository, conducted by Dr. Samuel L. Mitchill and others, in New York, commenced in 1798, and was continued with various editorial changes until 1824. It was the vehicle for a number of chemical contributions, and especially did Dr. Joseph Priestley near the close of his life publish in it several letters devoted chiefly to the defence of the phlogistic theory. It counted among its contributors also Dr. James Woodhouse, who was the antagonist of Dr. Priestley in the phlogistic controversy, Dr. McNevin, Dr. Griscom, and others.

The Philadelphia Medical Journal was the resort of Dr. Robert Hare, as well as of the authors before named; Coxe's "Medical Museum," in Philadelphia, the Baltimore Medical Journal, the New York Medical and Physical Journal, by Dr. Hosack and others; and the Boston Journal of Philosophy and the Arts need not detain us, as their objects were mainly medical, and chemistry was only incidental to them.

The chemical student of to-day will find little to reward him in his search in these border lands of our science.

In January, 1810, appeared in New York the first number of *The American Mineralogical Journal*, conducted by Dr. ARCHIBALD BRUCE, Professor of Materia Medica and Mineralogy, etc. This was the first journal entirely devoted to science, and supported exclusively by original American contributions, which appeared in the United States. It ceased with the appearance of its fourth number in 1814, and in all covers only 270 pages. It received the support of many of the working men of the times in its own departments, and contains the original record of many interesting observations in both mineralogy and chemistry, to some of which more particular reference will be made.

In 1817 appeared the first volume of the *Journal of the Academy of Natural Sciences of Philadelphia*, aided by the well sustained liberality of William Maclure, a name never to be forgotten in the history of American science. This journal, although essentially devoted to natural history, was also the vehicle for some early chemical contributions. We find among its contributors the names of Keating, Vanuxem, Morton, Troost, Bowen, H. Seybert, and others of the older chemists and mineralogists.

In July, 1818, appeared the first number of the *American Journal of Science*, conducted by BENJAMIN SILLIMAN, of Yale College. A perusal of the "Introductory Remarks" by the editor at the opening of the first number, reveals the spirit in which this undertaking was commenced. After paying a deserved tribute of respect and affection to Dr. Archibald Bruce, whose death had just then put an end to his journal, Prof. Silliman remarks: "Most of the periodical works of our country have been short-lived. *This* also *may* perish in its infancy; and if any degree of confidence is cherished that it will attain a maturer age, it is derived from the obvious and intrinsic importance of its undertaking; from its being built upon permanent and momentous national interests; and from the evidence of a decided approbation of the design on the part of men of the first experience, obtained in the progress of an extensive correspondence." The founder lived to see the completion of the first series of fifty volumes, and thirty-eight volumes of the second series in 1864, which closed the first century of volumes in 1870. This journal belongs, then, to both the historical and contemporaneous divisions of our subject, and in its successive indexes will be found the titles and authors of the larger number of the most important American contributions to chemistry.

It is not requisite to our purpose now to consume valuable time in enumerating the titles of the various journals, proceedings, and transactions which have appeared in constantly increasing numbers since 1818. They are familiar to all students of science, and few of them are specially devoted to chemistry. We should not fail, however, to name—

The Franklin Journal (now the *Journal of the Franklin Institute*), commenced by Dr. Thomas Jones, of Philadelphia, in January, 1826, under the auspices and as the organ of the Franklin Institute of Philadelphia. It has been continued monthly ever since, under various editorial changes, and has now just completed the sixty-eighth volume of its third series, which has lately passed under the editorship of Prof. George F. Barker, of the University of Pennsylvania, making, with thirty volumes in the first two series, ninety-eight volumes in all. This journal, although avowedly and

largely mechanical, has always been, to some degree, and especially of late years, a vehicle for original communications in physics and chemistry. Its life commenced with the opening of the semi-centennial of the century we celebrate.

The American Chemist, New York, is a monthly journal devoted exclusively to chemical subjects, under the editorship of Professors Chas. F. Chandler and Wm. H. Chandler. It was commenced in 1870, and has concentrated and called out an amount of original work and authorship in chemistry, which is the best evidence of the large number of working chemists now engaged in our science in the United States. In its pages appear, as in no other American journal, the full record of such occasions as this which we now celebrate, with full abstracts of foreign chemical papers in all languages.

Of the *Boston Journal of Chemistry*, and other more purely special or technical journals, of which each department of chemical art now counts one or more, we can speak only in the most general terms. Among these, however, we should by no means pass without special mention the *American Journal of Pharmacy*, which, from its commencement in 1825 to the present time, has been the repository of all that is most valuable in this branch of chemistry. In it are recorded the labors of Daniel B. Smith, R. E. Griffith, Geo. B. Wood, Bache, Carson, Hodgson, Durand, Parrish, Bridges, Bullock, Maisch, Mayer, and above all of W. Procter, Jr., whose untimely death still leaves him with a record the bare enumeration of which fills seven closely printed columns, comprising the titles of over six hundred articles, of which a large number are original. A general index to forty-two volumes of this journal was compiled in 1873, by H. M. Wilder—8vo. pp. 314. Philadelphia.

Transactions of Learned Societies.—In these we find the only record often of the early work of American chemists, and we will next consider some of the more important of these.

"*The American Academy of Arts and Sciences*," at Boston, was established by a charter of incorporation granted May 4th, 1780, and its first volume of *Memoirs*, to the end of 1783, appeared in 1785, in 568 pages, 4to. Of the fifty-four memoirs printed in this volume, the most numerous and important are the astronomical and mathematical papers, among which we cannot notice without interest at this time the observation of the transit of Mercury over the sun November 12th, 1782, by Rev. Philips Payson and James Winthrop, Esq.; nor can we fail to observe the very marked difference between the quality of the science developed in the astronomical papers, as compared to the meagre attempts to discuss chemical subjects. The volume contains only two papers which can be called in any wise chemical, viz., "*Observations upon the Art of Making Steel.* By the Reverend Daniel Little, F.A.A.," in which the author states it as the opinion of writers of the time "that the principal difference between iron and steel consists in this: that the latter is combined with a greater quantity of phlogiston than the former. Phlogiston exists in all inflammable substances, and in some that are not inflammable." And hence in cementation we must use a substance like charcoal, the coal of bones, etc., to form a "cement which contains the greatest quantity of phlogiston." The author's experimental addition to the art of making steel was in the use of the marine plant known as rockweed to form the cementing material, which he found to produce a superior quality of steel. The second chemical paper is a memoir entitled, "*Experiments on the Waters of Boston.*" By J. Feron, a Surgeon-major in the French fleet then stationed near Boston, printed both in French and English. This appears to be the earliest attempt at the chemical examination of water in this country. In the sea-water taken at the head of the "*Long Wharf*," he finds on evaporation 472 grains of solid residue in an English quart, which, dissolved in distilled water, left on the filter 6 grains of "calcareous earth" (probably gypsum). The filtered solution being evaporated, left 400 grains of "sea salt, with an alkaline basis" (sodium chloride), "from 40 to 47 grains of sea salt with the terene basis, or *sal. cathart. amar.*" (meaning magnesium sulphate), "and a small quantity of oil" (meaning probably magnesium chloride). He also examined the pump-water in common use at that time, and finds it near the sea contaminated with marine salts. That from Beacon Hill, Charter street, and New Boston, was nearly free from impurities. He tested their hardness by soap, determined their specific gravity and temperature, and "by the alkaline lixivium used for making Prussian blue" (yellow cyanide of potassium) he proved the absence of "any metallic principle" (*e. g.*, iron), and then compared the pump-water with distilled water, in forming tinctorial infusions in vials of equal size, using as his test equal quantities of pulverized rhubarb exposed to the same degree of heat, and also repeating the trial with cochineal logwood, and beet juice, detecting in each case the difference of color due to the presence of alkaline salts. He also used nutgalls with "the fixed alkali" (potassium carbonate, probably), "which turned it to a deep green." He inferred from these tests the presence of earthy and alkaline salts, "with some marks of the marine acid." He used silver nitrate and solution of mercury, and obtained the appropriate insoluble chlorides. By a solution of fixed alkali he obtained also a white precipitate of about six grains to the quart, "which dissolved in acid with effervescence" (calcic and magnesian carbonates). Left at rest in bottles, some of these waters gave off "a quantity of air, rising in bubbles to the surface," and let fall a small sediment. "Lime-water dropped into these waters formed a white cloud, and detached a precipitate of the same color." The water of *Beacon Hill* and *Charter street* gave no such precipitate with the alkalies nor with lime-water. He asks if the reaction with lime-water and the escape of air-bubbles does not indicate an earth, suspended by means of a superabundance of air (meaning carbonic acid). He then proceeds to determine the solid residue by evaporation, and with considerable skill to estimate the chief constituents of the saline mass, using the methods of analysis then known. His paper, translated into modern chemical terms, would not be esteemed an unworthy contribution to-day; and considering the fact that there was then hardly one seat of learning in America where chemistry was recognized even by name in the curriculum of study, nor was there then an operative laboratory, we must regard with respect this early contribution to the science. It certainly exhibits a truly scientific spirit, reflected, no doubt, from the French schools, in which the author was probably trained. Dr. Feron communicated to the Academy a "Second Essay on the Boston Pump Waters," which is contained in vol. ii. p. 170 of the *Memoirs of the Academy*, 1790–93.

Dr. Samuel Tenney, surgeon to one of the Massachusetts regiments during the Revolutionary war, being stationed near Saratoga, sent to the Academy at Boston in Sept. 1, 1783, "An account of a number of medi-

cinal springs at Saratoga, in the State of New York." This, I believe, is the earliest record we have of these now renowned mineral springs, which had been first observed by the surveyors only thirteen years before; and prior to Dr. Tenney's visit and description they had been frequented only by a few poor people from the immediate neighborhood. Dr. Tenney very accurately estimates and foretells the importance of these saline waters. He gives a clear and intelligent account of the mode of their occurrence, and shows his sagacity by his experiments made on the spot with only such agents as his medical chest afforded to determine the chemical character of the waters. He distinctly recognizes their alkaline character. One he finds to be a chalybeate, and in all he finds "fixed air" to be the agent holding the "calcareous earth" and iron in solution. He says, "It is obvious these waters are essentially the same with the acidulæ of Pyrmont, Seltzer, etc., which have been so famous in Europe." From the great accumulation of calcareous deposits left by these waters he concludes that the flow of water must have been formerly much greater than at the time of his observations, and he reasons hence that these springs have all the appearance of being in a state of decay. His speculations as to the cause of the fault or break in the rocks along the line of which the springs are situated are curious. He finds the elastic power of "fixed air" set free from the lime rocks, by the "vitriolic acid" which "abounds in the subterranean regions, an adequate cause to produce such an explosion as would burst asunder the most solid rocks, leaving reservoirs to be filled with water charged with carbonic acid, forming a proper menstruum for dissolving the calcareous earth or iron ore which it might meet in its passage." He cites many cases of the medicinal value of the waters administered under his own directions to the men of his regiment.

Dr. Tenney's account of the Saratoga waters did much to bring these springs into general notice. It is curious to compare his chemical results with the recent analyses of the same waters by our colleague, Dr. C. F. Chandler, in evidence of the difference afforded in this comparison of the state of the art of analysis at the two periods, nearly a century apart.

With the exception of two technical papers on the manufacture of solar salt at Cape Cod, and on the manufacture of potashes, the latter by Aaron Dexter, of Harvard, there are no further chemical papers in the volumes of the American Academy for a long course of years.

The Connecticut Academy, and the Weston Meteor, Professors Silliman and Kingsley.—The Connecticut Academy of Arts and Sciences was incorporated by the Legislature of that State in the year 1799. In the first volume of its memoirs, published in 1810, will be found "An account of the meteor which burst over Weston, in Connecticut, in December 1807. By Professors Silliman and Kingsley" (pp. 141–163). No scientific paper had before appeared in the United States which excited so much attention and comment as this. Owing to the extraordinary nature of the phenomena described, and, no doubt, also, to the fairness and vigor of its description, this paper was very generally reproduced. It was read, March 4, 1808, before the American Philosophical Society, and appeared in the Transactions of that Society (vi. pp. 423–443, 1809). Contrary to a standing rule, to take no notice of matters appearing in the public prints, this paper was also read, at the time, before the Royal Society at London, and the French Academy at Paris. Thomas Jefferson, then president of the American Philosophical Society, is reported to have said on this occasion, in the well-known language of David Hume regarding miracles, "that it was easier to believe that two Yankee Professors could lie than to admit that stones could fall from heaven"—a remarkable evidence of the limited knowledge of such subjects then prevailing in this country, even in the minds of the most cultivated people. But it is chiefly with the chemical side of this paper we are now concerned. It contains, under a separate heading, a "Chemical examination of the stones which fell at Weston (Connecticut), December 14, 1807. By B. Silliman, Professor of Chemistry in Yale College." This examination extends to each of the constituent parts of the stone, viz: 1. Of the stone at large. 2. Of the pyrites. 3. Of the malleable iron. 4. Of the black irregular mass. 5. Of the crust. 6. Of the globular bodies. The chemical portion of this memoir is the earliest research of the kind of which we have any account in this country. There was not at that time a laboratory fitted with the appliances needful for accurate analytical research. The weighings were made on a common pharmaceutical balance, with weights of only ordinary accuracy. There was then no book or treatise on analytical chemistry accessible here, beyond the special work of former investigators, given in their memoirs. Prof. Silliman appears to have followed in this case the memoirs of Vaquelin and Howard, in their analyses of the meteoric stone of Benares, and beyond this to have been guided by his own sagacity.

The Oxyhydrogen Blowpipe of Dr. Hare, 1802.—Probably no chemical discovery made in this country has been more generally cited or less generally understood in its scientific significance, than the oxyhydrogen blowpipe of Dr. Hare; or, as it was called by his colleague, Prof. Silliman, "Hare's Compound Blowpipe." Having some knowledge of the facts, I propose to review them briefly, and to show that this was in reality a memorable scientific event.

No one can read the original memoir by Dr. Hare in *Tilloch's Philosophical Magazine* (xiv. 1802, pp. 238–245 and 298–308), without perceiving in it the evidence of a truly philosophical mind, proceeding by successive steps in a most natural order of induction from a simple attempt to improve the ordinary hydrostatic blowpipe to the discovery of a philosophical principle far in advance of the science of the time. Dr. Hare's paper was entitled "Memoir on the Supply and Application of the Blowpipe. By Mr. Robert Hare, Jr., member of the Chemical Society of Philadelphia." ("Published by order of the Society.") The author was at that time about twenty years of age. The Chemical Society of Philadelphia appears not to have been a publishing society, and Dr. Hare's original memoir, although separately published as a pamphlet in Philadelphia in 1802, was never, so far as I can discover, reproduced in any American scientific journal or transactions. It is reproduced as an "Extract" from M. P. Aadet in the *Annales de Chemie*, 30 *Pluviose, an.* xi. (tome xlv. 113–138). A second paper by Dr. Hare, supplementary to his first, appeared in the Transactions of the American Philosophical Society at Philadelphia, in 1804, under the title "Account of the fusion of Strontites and volatilization of Platinum, and also a new arrangement of apparatus" (vi. pp. 99–105). This paper was read June 17th, 1803. In it he reaffirms his former results given in his first memoir, adding those on the fusion of strontia and the volatilization of plati-

num, and describes the form of apparatus executed by Prof. Silliman at Yale College, in which the gases were confined within the pneumatic trough. In this paper, with characteristic generosity, he recognizes his obligations to Prof. Silliman, his associate in conducting these experiments. The term "Compound Blowpipe" was first given to Hare's apparatus by Prof. Silliman, who also in 1812 describes his form of the apparatus more at length in the *Memoirs of the Connecticut Academy*. This paper of Prof. Silliman, "On the powers of the Compound Blowpipe," was reproduced in Bruce's *American Mineralogical Journal*, p. 199.

In the Transactions of the American Philosophical Society, Philadelphia (vol. iii, pp. 328–339), is a paper read May 7th, 1812, entitled "Experiments on the Fusion of various refractory Bodies by the Compound Blowpipe of Dr. Hare. By Benjamin Silliman, Professor of Chemistry and Mineralogy in Yale College." This paper is prefaced by "A section of the Pneumatic Cistern of Yale College, with the Compound Blowpipe of Mr. Hare burning hydrogen and oxygen gas." This arrangement of the oxyhydrogen blowpipe by Prof. Silliman was extensively reproduced in other laboratories, and was adopted substantially by Dr. Hare. The double platinum jet with converging ducts forming the continuation of two solid silver tubes, and uniting in a common passage, somewhat larger just before their exit, at the common orifice below, joined by screws to avoid solder, were Mr. Silliman's mode of construction, and it was with this jet he conducted the "experiments on the fusion of various refractory bodies," as detailed in this paper, which relates the results of experiments upon more than thirty of the most refractory bodies known, many of which had never before been fused. This paper was republished in *Tilloch's Magazine*.

In the third edition of Henry's Elements of Chemistry (1814), edited by Prof. Silliman, the Pneumatic Cistern of Yale College is figured on the frontispiece with the inscription "Showing the compound blowpipe for oxygen and hydrogen from the original constructed by Prof. Silliman, and invented by him and Dr. Hare."

In September, 1816, Dr. E. D. Clarke, the well-known traveller, and then Professor of Mineralogy in the University of Cambridge (England), published simultaneously in the *Quarterly Journal of the Royal Institution* (London), vol. ii, p. 104, and in the *Ann. de Ch. et Phys.*, tome iii, p. 39, his "account of some *experiments made with Newman's Blowpipe, by inflaming a highly condensed mixture of the gaseous constituents of water*," etc. Newman, the well-known instrument-maker in London, had, a few months before (April, 1816), described in the *Journal of the Royal Institution* (vol. i, p. 65), his blowpipe, in which air was compressed by a syringe. He does not appear to have contemplated the use of any gas but common air. Dr. Clarke, in a foot-note to his paper above cited, refers to Dr. Hare's paper of 1802, but he makes no reference to Prof. Silliman's very full statements of his results on the fusion of refractory bodies made in 1811, and published in 1812. That he had not seen this paper is certainly possible. A comparison of the results obtained by these two observers shows, however, a singular identity in most of the details not easily accounted for. Prof. Silliman, after the publication of Dr. Clarke's paper, made a reclamation, which was published in the *Journal de Physique* at Paris, for January 1818, and is reproduced with comments in the first volume of *Silliman's Journal*, p. 97. Dr. Clarke subsequently published a book entitled "On the Gas Blowpipe" (1819), which at once called out from Dr. Hare his "Strictures," etc., which appeared in the second volume of *Silliman's Journal* for 1820 (pp. 281–302). This is a good example of the vigor and thoroughness with which Dr. Hare was wont to deal with those who encroached on his rights. No explanation was ever offered by Dr. Clarke for his clear trespass upon the researches of his American contemporaries, although the whole case was fairly laid before him.*

We have already mentioned that the American Academy at Boston selected the oxyhydrogen blowpipe of Dr. Hare for the honor of the first award ever made by them from the Rumford medal fund, which had been accumulating on their hands for more than forty years. It was fit that an American discovery which had been almost coeval with the institution of the Rumford medals, should have been selected for this decoration. It might seem ungracious in us to ask why it was so long delayed, seeing it was at length so worthily bestowed.

We have dwelt somewhat at length upon the historical portion of Dr. Hare's discovery; we now return to say a few words of its merits as a discovery.

That Dr. Hare deserved the title of a discoverer, and not merely the lesser distinction of an inventor, will appear, if we remember that he had the sagacity to recognize, in his original memoir, the fact overlooked by Lavoisier and other experimenters in the same field, that in order to obtain the maximum possible effects of heat, the body to be heated must be sustained *in an atmosphere of burning gas*, and that charcoal, impinged upon by a jet of oxygen, did not fulfil this condition. Hence Hare, after discussing the fundamental defects of Lavoisier's methods, says, with great sagacity, "To avoid these evils, it was thought desirable that means might be discovered of clothing the upper surface of any body which might be subjected to this species of operation with some burning matter, of which the heat might be equal to that of the incandescent carbon with which the lower surface might be in contact; or by which bodies might be exposed on solid supports to a temperature equal or superior to that of the porous charcoal uniting with oxygen."

"It soon occurred that these desiderata might be attained *by means of flame*, supported by the hydrogen and oxygen gases; for it was conceived that, according to the admirable theory of the French chemists, more caloric ought to be extricated by this than by any other condition. * * * * *

"Such was the reasoning which originated the desire of employing the flame of the hydrogen and oxygen gases. But before this could be accomplished, it was necessary to overcome the difficulty of igniting a mixture of these aeriform substances without the danger of an explosion."

These are remarkable words to have been written in 1802. They show their author to have possessed equally the higher powers needed to seek for and discover a great principle, and the lesser power to devise the means to apply it in a mechanical combination. The discovery precedes the invention—the discoverer is master to the inventor. Rarely, as in Hare's case, do we find the two sets of powers combined. Every real discovery is the fertile parent of many inventions. Rumford's paper on the "Source of the Heat excited

* A perfectly fair and impartial statement of the facts respecting the blowpipe of Dr. Hare will be found in the *Ann. de Ch. et Phys.*, 1820, tome x[illegible], p. [illegible], by Gay-Lussac: "*Sur la Fusion de divers corps réfractaires avec le Chalumeau de* HARE." This statement is translated in vol. [illegible] of Silliman's Journal, p. [illegible], 1821.

by Friction," which had been communicated in substance to the Royal Society in 1798, was not published in their Transactions until 1800, and could hardly have been known to Hare in 1801, when he made his discovery. Indeed the philosophical conclusions flowing from Rumford's researches on heat were slow in making their way, and the step was a long one from the phenomena of heat as connected with motion, to the fundamental idea developed by Hare—such a long step as to leave the entire originality of Hare in this case beyond question.

Properly considered, the fundamental principle which led Hare to the invention of the oxyhydrogen blowpipe has also led Siemens in our time to the invention of the regenerative gas furnace, by which, as Hare says in the memoir already quoted, "To avoid these evils" (viz., the contact of solid fuel and the loss of heat consequent on its conversion into gas), it was thought desirable that means might be discovered of clothing the upper surface of any body" to be heated "with some burning matter," . . . . "or by which bodies might be exposed on solid supports to a temperature equal or superior to that of the porous charcoal uniting with oxygen." "It soon occurred that these desiderata might be attained by means of flame supported by the hydrogen and oxygen gases."

In the Siemens furnace the objects to be heated are sustained on a solid support in an atmosphere of burning gas, the oxygen of the atmosphere arriving by one inlet, and the combustible gases by another, and the two uniting in a true Hare's blowpipe flame to do their work. The accessory contrivances for the alternation of the flow of gas and air through the regenerative cellular flues of fire-brick, are evidences of a high degree of inventive skill, applied to the solution of a problem which, in its essential features, was clearly set forth by the American philosopher, Robert Hare, in 1802, in his memoir which we have just been considering.

Of Hare's other Contributions to Science.—It is well in this connection to refer briefly to the labors of Dr. Hare in other departments of chemical and physical research.

It will be remembered that the award to him by the American Academy, in 1839, from the Rumford Medal Fund, was equally for his "improvements in galvanic apparatus" as for his blowpipe.

In 1819 Dr. Hare published his memoir entitled, "A New Theory of Galvanism, supported by some experiments and observations made by means of the calorimoter, a new galvanic instrument" (*Silliman's Journal*, i. p. 413). In view of our present notions in molecular physics, we may perhaps smile at the statement by which the author opens his paper. "I have," he says, "for some time been of opinion that the principle extricated by the voltaic pile is a compound of caloric and electricity, both being original and collateral products of galvanic action." Yet we cannot fail to observe that this statement, if clothed in the language of modern science, is a distinct recognition of what we call the correlation of forces. In Hare's calorimeter we have a form of apparatus which is admirably adapted to develop a large quantitative flow, and one which has now a wide use for this purpose, the substitution of plates of carbon for copper and of amalgamated zinc for the unprotected metal, being the only changes which modern art has introduced into Hare's original instrument, long forgotten, and perhaps before unknown to the existing generation, but now revived again, and permanently installed in the laboratory of the physicist.

In 1821 Dr. Hare published his memoir entitled, "A Memoir on some New Modifications of Galvanic Apparatus, with Observations in support of his New Theory of Galvanism" (*Silliman's Journal*, iii. p. 105; also, in the *Phila. Med. Journal*). In this memoir he describes his "deflagrator," which may be considered as a mobilized voltaic pile, capable of instantaneous immersion in the exciting fluid, and of equally instant suspension. In place of the laborious process of filling by hand the troughs of Cruickshank or Wollaston, Hare supplied the means of bringing any number of voltaic couples into immediate action, without the loss of an instant of time, and thus, for the first time, secured a maximum effect, which, in the previously existing instruments, was impossible.

It happened, as a consequence of the general adoption here of Hare's form of the voltaic pile, that powerful deflagrators were in common use in America long before any apparatus of equal power was known in Europe; for it was not until 1836 that Daniell discovered the double-cell battery, and a little earlier that Kempt had shown that amalgamated zinc would resist the local action, which, prior to that observation, prevented the construction of sustained, or so-called constant batteries. In the absence of these two important discoveries, Hare's forms of voltaic apparatus were the best possible, and well deserved the reward they received at the hands of the American Academy. Faraday, in his Experimental Researches, very honorably conceded to Dr. Hare all that his warmest friends could ask. After recounting the steps by which he had himself been led to the same mode of construction, he adds: "On examining, however, what had been done before, I found that the new trough was, in all essential respects, the same as that invented and described by Dr. Hare, Professor in the University of Pennsylvania, to whom I have great pleasure in referring it." (vol. i. p. 345, § 1123, *Experimental Researches*, June, 1835.)

The perusal of Dr. Hare's papers, above referred to, as well as his numerous controversial and other discussions with other authors, will clearly show that he always held his qualities as an inventor quite subordinate to his theoretical views, and that the latter were ever prompting him to new researches. His discussion with Faraday on Induction (*Expt. Res.*, ii. 251, 1839–40), and his letters to Berzelius and to Liebig, on Theoretical Chemistry, are in point. The general index to the first series of *Silliman's Journal* contains the titles of no less than 150 papers by Dr. Hare, upon a great variety of chemical and physical subjects, the mere enumeration of which would far transcend our present limits.

Before leaving this subject, it is proper to say that the deflagrator of Hare in 1822 enabled Prof. Silliman to announce the fusion and volatilization of carbon, and the actual transfer of the volatilized portion of the positive electrode to the negative pole, by which the former is made cup-shaped and diminished in length, while the latter is sensibly elongated (*Am. Journ. Sci.*, [i.] v. 108). This fact was disputed by Vanuxem and others, but was amply confirmed much later by Despretz, who further detected on the walls of the inclosing glass egg, within which the arch for 600 Bunsen couples was brought to bear on the diamond, minute crystals of carbon obtained from the vapor of the volatilized diamond.

On the 15th of May, 1858, Dr. Hare died at the advanced age of seventy-eight years. In the following number of the *American Journal of Science*, his old friend and associate, himself then in his eightieth year,

presented the following tribute to his early and life-long co-laborer, which we reproduce in this connection, even at the risk of some repetition of what has already been said, as a proper supplement to our notice of two of the best known contributors to chemical science in this country of the past generation.

"*The late Dr. Robert Hare.*—During the progress of the forty years of our editorial labors, sorrow has often been awakened as we have been called to record the departure from life of friends and fellow-laborers in the common cause.

"Robert Hare, the distinguished chemist and philosopher, who died in Philadelphia on the 15th of last May in the seventy-eighth year of his age, is entitled to a grateful commemoration in this Journal, to whose pages his contributions were for many years more numerous than those of any other correspondent. The enumeration of the titles merely of about one hundred and fifty articles furnished by him, occupies five columns of the general index of the first fifty volumes of the Journal. He appears in forty-one of those volumes, and in seven volumes of the Second Series.

"For more than half a century his name has been familiar to men of science as a chemical philosopher, and to the cultivators of the useful arts throughout the civilized world.

"Dr. Robert Hare was born in Philadelphia, January 17th, 1781. His father was an Englishman, a man of strong mind, and honored in his adopted country by the public confidence. His mother was from a distinguished Philadelphia family. In early life he managed the business of an extensive brewery, which his father had established, but his strong leaning toward physical science very early manifested itself, and soon led him to abandon the pursuits of a manufacturer and devote his talents and fortune to science. Before the age of twenty he gave evidence of this predilection for scientific pursuits by following the courses of lectures on chemistry and physical science in his native city, and by uniting himself with the Chemical Society of Philadelphia, then embracing the names of Priestley, Sybert, and Woodhouse.

"In 1801 he communicated to this Society a description of the oxyhydrogen blowpipe, which he then called a '*hydrostatic blowpipe.*' Prof. Silliman, having been much engaged with him in a series of experiments with this instrument in 1802–3, subsequently distinguished it as the 'compound blowpipe.' having, in fact, on his return from Philadelphia in 1803, constructed for the laboratory of Yale College the first pneumatic trough combining Dr. Hare's invention; an apparatus subsequently figured and described by Dr. Hare in his memoir 'on the fusion of strontia and volatilization of platinum.'* His memoir to the Chemical Society was separately published in 1801, and was republished in *Tilloch's Phil. Mag.*, London, 1802, and also in the *Annales de Chimie* (1st series), v. 45.

"This apparatus was the earliest and perhaps the most remarkable of his original contributions to science. It was certainly evidence of a highly philosophical mind, that Dr. Hare, in that comparatively early period in modern chemistry, and when the received notions of the true nature of combustion were so vague, not to say erroneous, should have had the acumen to conceive that a stream of oxygen and hydrogen burning together should produce so intense a heat. Lavoisier, certainly one of the most acute of chemical philosophers, and unsurpassed in his skill as an experimentalist, had beaten up the same path so far as to direct a jet of oxygen upon charcoal, and he thus produced a degree of heat by which he fused alumina and other bodies before deemed infusible. He had even brought the elements of water into the same vessel, and had there burned them from separate jets, in his famous apparatus for the recomposition of water. But it seems never to have occurred to him that here was a source of heat greater than any then known. In our view, Dr. Hare's merit as a scientific philosopher is more clearly established upon this discovery than upon any other of the numerous contributions he has made to science. His original experiments were repeated in 1802–3 in presence of Dr. Priestley, the discoverer of oxygen, then on a visit to Philadelphia, and of Silliman, Woodhouse, and others. They were subsequently greatly extended by Prof. Silliman, who, with the apparatus already alluded to, subjected a great number of refractory bodies to the action of the oxyhydrogen jet, and published an account of his results in the *Memoirs of the Conn. Acad.*, May 7th, 1812.

"The discovery of the oxyhydrogen blowpipe was crowned by the Amer. Acad. at Boston by the Rumford medal.

"The historian of science will, in view of the facts here quoted, find it needless to notice the disingenuous effort of Dr. Clarke of Cambridge, England, in his '*gas blowpipe,*' to overlook or appropriate the discovery of Dr. Hare, and the researches of Silliman and others, several years after (in 1819) this discovery had been fully before the scientific world—an effect which must ever remain as a sad stain upon the reputation of this otherwise distinguished man.*

"It is not our purpose here to rehearse the history of Dr. Hare's discovery in full, much less to describe all the modifications which the apparatus has received at the hands of its original discoverer and others. It is well known that in later years he constructed the apparatus on a gigantic scale, with large vessels of wrought iron capable of sustaining the pressure of the Fairmount water-works, and that with this powerful combination he was able to fuse at one operation nearly two pounds of platinum.† In these experiments the metal is held upon a refractory fire-brick, and both are heated as highly as possible in a wind furnace before submitting it to the gas-jet. The product of this fusion from the crude grains is found to be greatly purified, a result probably due to the volatilization at this intense heat of some of the associate metals.

"The employment of Dr. Hare's jet to illuminate lighthouses and signal reflectors under the names of Drummond light and Calcium light, is only another example of the mode of ignoring the name of the real discoverer, of which the history of science presents so many parallels.

"The fertility of Dr. Hare's inventive mind is illus-

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* Trans. Am. Phil. Soc., vol. vi. p. 99, and plate 3 (June 17, 1803).

* The reader will peruse with interest, in this connection Dr. Hare's elaborate defence of his own claims and those of his associate, Prof Silliman, against Dr Clarke's appropriation, in this Journal [1], vol. ii. pp. 281–302, 1820. Dr. Clarke, after a full and spirited protest had been communicated to him, stating fully Dr. Hare's claims and the wrong done him, failed to make any acknowledgment of his error, thus exonerating us from the force of the old maxim, "*Nil de mortuis nisi bonum.*" Dr. Hare heads his strictures on Dr. Clarke's book with the well-known lines of Virgil, "*Hos ego versiculos feci, tulit alter honores,*" etc.

† Roberts in New York has lately with Dr. Hare's apparatus succeeded in fusing perfectly 53 oz. of platinum at one operation, and Deville has by the same means more recently fused one hundred and fifty pounds of platinum at one operation, in obtaining the metal for the new standards of measure.

trated by the numerous and ingenious forms of apparatus which he contrived for research or illustration. To many of these he was led by the necessity of preparing the illustrations for his lectures upon a scale of magnitude adequate to the instruction of the large classes of the Medical School of the University of Pennsylvania. He was called to fill the Chair of Chemistry in that institution in 1818, and continued in the discharge of its duties for nearly a third of a century, and until his resignation in 1847.

"He was fond of graphic illustrations; they abound in his memoirs and in his Compendium and other works, and aided by his lucid descriptions his inventions thus become quite intelligible. Where most instructors are satisfied with less perfect and more simple means and explanations, he seemed to be content with nothing short of perfection.

"During his long course of research and experimenting, he accumulated a vast store of instruments and materials. An inspection of his repositories and the treasures there accumulated filled the observer with astonishment, and in his lecture-room there was always a profusion of apparatus, often instruments of great dimensions, corresponding well with his large mind, with his great physical and intellectual power, and unquenchable ardor. He was himself an able and skilful mechanic, and often worked adroitly at the turning lathe and with the other resources of a well-furnished shop. In his operations he spared neither labor nor expense, and bestowed both munificently for the accomplishment of his objects.

"He devoted great labor and skill to the construction of new and improved forms of the voltaic pile, and it is easy to show, that, owing to his zeal and skill in this department of chemical physics, American chemists were enabled to employ with distinguished success the intense powers of extended series of voltaic couples long in advance of the general use of similar combinations in Europe.

"It was with one of Hare's deflagrators that Silliman in 1823 first demonstrated the volatilization and fusion of carbon, a result considered so extraordinary at the time that it was long received with incredulity. Since the general introduction of Bunsen's battery, these effects are no longer doubted; all Prof. Silliman's results having been confirmed and extended by Despretz, De La Rive, and others.

"The deflagrator was invented in 1820.* Four years earlier Dr. Hare had contrived another instrument which he called *the Calorimotor.* In this instrument great extent of surface was obtained from the combining of many large plates (18″ or 24″ square) of zinc and copper into two series, and plunging the whole at one movement into a tank of dilute acid. The magnetic and heating effects of this instrument were surprising, and to this day no other form of voltaic apparatus appears to occasion the movement of so great a *volume* of heat with so low a projectile or intensitive force. By it, large rods of iron or platinum, when clamped between its jaws, are first fully ignited and then fused with splendid phenomena, while at the same time its intensity is so low that hardly the least visible spark can be made to pass by it through poles of carbon.

"In the philosophy of chemistry, Dr. Hare has distinguished himself for the zeal and logical acumen with which he combated what he conceived to be the errors of the salt radical theory. He was ready at all times to engage in controversy upon any point of theory where he conceived there was an error latent. No one can review the numerous letters which he has addressed to the senior editor of this Journal, to Berzelius, to Liebig, and to Faraday, and published in this Journal, without perceiving that he was no ordinary antagonist.

"In his family and among his friends Dr. Hare was very kind, and his feelings were generous, amiable, and genial, although occasionally his manner was abrupt—from absence of mind occasioned by his habitual abstraction and absorption in thought; his mind was ever active, and conversation would sometimes seem to awaken him from an intellectual reverie. He had high colloquial powers, but to give them full effect, it was necessary that they should be roused by a great and interesting subject, and especially if it assumed an antagonistic form. He would then discourse with commanding ability, and his hearers were generally as willing to listen as he was to speak.

"He was a man of unbending rectitude, and a faithful friend both in prosperity and adversity.

"His frame was robust—powerful and ample in structure, and of strong muscular development, having been invigorated in earlier years by skilful training; and, had there been occasion, he would have made a formidable physical antagonist. His head was large and of noble model; no stranger could meet him without being impressed by a figure of such grandeur and a head and features so remarkable.

"Dr. Hare was an ardent patriot, who loved his country and cherished its institutions not for office or emolument, which he never sought or received, but from pure and lofty motives. He was of the school of Washington—an enthusiastic admirer of that great man—a federalist, while that primeval party had a name and retained vitality—and when it passed by an imperceptible transition into another form, he was found among the whigs. He occasionally wrote upon the great political and financial questions which agitate the public mind. These discussions, like all his writings, were always marked by vigorous thought, large views, and elevated patriotism.

"He was not, however, so exclusively a man of science as to ignore the charms of literature. His particular friends know that his philosophy was sometimes softened by listening to the Muses, and he occasionally indulged in poetical composition.

"Dr. Hare was one of the few life members of the Smithsonian Institution, to which he gave, soon after he resigned his professorship, all his chemical and physical apparatus, which has thus become the property of the nation."

BENJAMIN SILLIMAN.—At the time when the chair of chemistry was first occupied by Prof. Silliman in Yale College, in 1802, chemistry as a science was almost unknown in the United States, and, as we have seen, very few contributions had then been made to it in this country. Prof. Silliman fully recognized his obligations to Dr. John Maclean, of Princeton, where he made a pilgrimage immediately after his appointment, and from whom he early obtained a list of books for the prosecution of his studies. Princeton was thus an authority in chemistry before Yale had taken her first lessons in this science. Priestley's arrival here in 1794, and his inspiring influence, both by his occasional presence in Philadelphia and by his communications to the American Philosophical Society, naturally made Philadelphia the point of chief attraction in the United States

* Sill. Journal [1], vol. iii. p. 105.

to the chemical student at the commencement of the nineteenth century. Here Professor Silliman found Dr. James Woodhouse filling the chemical chair in the University of Pennsylvania, on whose lectures he was a faithful attendant. But he was not long in discovering that he made more real progress in the study of chemistry by availing himself of the advantages of a small laboratory which he and a young man by the name of Robert Hare united in fitting up with a little apparatus and limited means of research. There these zealous young students worked together, elaborating the compound blowpipe, previously contrived by Hare, and of which the history has already been given. His chemical work upon the Weston Meteorite has also been noticed. His "Elements of Chemistry in the order of the Lectures given in Yale College" was published in two volumes in 1830, and embraced the fruits of a long course of successful experience in demonstrative chemistry, and was, with the exception of Gorham's, the first systematic work on our science in this country, which was not a reproduction of some European treatise.

Prof. Silliman made important contributions to chemical science, as we have seen; but far more important than his researches, to the advancement of this department of knowledge, was his remarkable power as an expounder of its truths in his lectures. It is not for us to enlarge further upon this subject, nor is it needful, seeing that the work has already been done by the graceful pen of Dr. Fisher, his biographer. It is, however, but just to add, in passing, that between the years 1830 and 1850 Prof. Silliman appeared frequently as a public lecturer on science in other cities and in very distant parts of this country, and was the first college professor who ventured to step from his rostrum to teach the people. With what measure of success he accomplished this task, without loss to the dignity and high office of science, has already been recorded by other pens. That these lectures had an important influence as an active element in the great awakening of the popular mind toward science, elsewhere noticed in this essay, cannot be doubted, and it were easy to trace his influence in deciding the action of some of those who have since made important endowments for science.

His editorial labors, both in the successive editions of Dr. Henry's Chemistry, and far more in the *American Journal of Science*, have already been noticed. He filled the chairs of chemistry and mineralogy at Yale College for fifty years, during which geology, as a science, was developed and added to his duties. By securing early in his career the extensive mineralogical collection of Col. G. Gibbs to Yale College, he gave this department of science great prominence there, and rendered the development of the geological department comparatively easy.

Of his early contributions to chemistry we have already said something; it is hardly needful here to add the titles of his various papers, about sixty of which will be found in the catalogue of the Royal Society.

He was an industrious and zealous worker in the laboratory, and eminently successful as a demonstrator. In 1808 he, immediately upon the announcement of Davy's discovery of the metallic bases of the alkalies soda and potassa, repeated Davy's methods by the voltaic pile, and verified his results (see *Bruce's Journal*, pp. 88 and 134), and he reproduced in full the memoir by Gay-Lussac and Thénard on the furnace process for potassium, in his third American edition of Henry's Chemistry. His scientific life was at many points intimately associated with that of Dr. Hare, and we have already illustrated this fact by what has been said of the researches of the latter philosopher.

Prof. Silliman wrote on many subjects besides science. His "Journal of Travels in England, Holland, and Scotland and of two passages over the Atlantic in 1805 and 1806" (3 vols.), was very generally read, and early made his name widely known. A visit to Europe was then a remarkable event, and no educated American had, before him, recorded his experiences. "Europe Revisited" (2 vols.) was published in 1853, and an earlier volume, "Tour from Hartford to Quebec in the Autumn of 1819," is a pleasantly written narrative, full of interesting historical data with reference to the early occupation of the country by the French.

ADAM SEYBERT is one of the few American chemists who enjoyed the advantage, rare at that time, of a training in the School of Mines at Paris, late in the last century. He has left but few papers, but his memoir, read before the American Philosophical Society, March 20, 1797, entitled "Experiments and Observations on Land and Sea Air," is of interest as the earliest example of such a research on our records. It relates the results of twenty-seven analyses of air made by the author at sea in a voyage across the Atlantic, and also the comparison of these results with other analyses made by him on land, near Philadelphia, by which comparison he reaches the conclusion that the air over the sea is purer than that over the land; that, while the latter varies with locality, the former is nearly constant; and he then modestly ventures the suggestion that "perhaps the impurities are absorbed by the agitation of the waves"—a conclusion to which modern investigation by the use of more exact methods has also arrived. Considering the imperfect condition of eudiometric methods in Seybert's time, his research and conclusions therefrom are decidedly creditable to his skill and sagacity. Dr. Seybert was the father of Mr. Henry Seybert, of whose contributions to chemical mineralogy we shall speak more at length. It was ADAM SEYBERT, who a few years later performed the office of his great namesake in the Garden of Eden, by naming the few minerals then forming the collection of Yale College, when submitted to him in 1805 by Prof. Silliman.

ARCHIBALD BRUCE, M.D., was both a chemist and mineralogist as well as a man of profound medical attainments. His name is associated with the *American Mineralogical Journal*, of which he was the projector and editor in 1810–14. It is pleasant to recall the fact also that his first chemical analysis "Of native magnesia from New Jersey" made known to science the beautiful mineral found in the magnesian rocks of Castle Point at Hoboken, New Jersey, which now bears the name of Brucite. He had also the sagacity to detect and correctly analyze the red zinc (zincite) of Sussex in New Jersey, associated with the Franklinite, two of the most distinctive and beautiful of American minerals. Some of the French authors still distinguish the zincite, erroneously, as Brucite. He also published a valuable paper "on the ores of titanium occurring within the United States." Dr. Bruce collected a valuable mineralogical cabinet. He died early (in 1818), in his 41st year. A fine engraved portrait of Dr. Bruce is preserved in the first volume of *Silliman's Journal*.

W. LANGSTAFF, M.D., New York.—Dr. Langstaff, when the assistant of Dr. Archibald Bruce, in 1811, made the first American analysis of chondrodite (then called *Brucite*). Indeed we may say this was the first mineral analysis of any difficulty (if we except the

analysis of the Weston meteor by Prof. Silliman in 1807–8) made in this country. Berzelius had failed to detect the presence of fluorine as a factor in this species in his analysis of the variety from Finland. Dr. Langstaff's analysis of the Sparta mineral first detected the fluorine, and his analysis gives very nearly the correct constitution of the species (*Dana, Min.*, 1868, p. 364–65). This fact entitles Dr. Langstaff to honorable mention among American chemists, although I have failed to detect any other example of his work.

Joseph Cloud, Assay Master in the U. S. Mint at Philadelphia, made, in 1807, an interesting research upon a native alloy of palladium and gold from Rio des Mortes, in Brazil. This metal had not before been found combined with gold, and all knowledge of it was confined to Dr. Wollaston's researches in 1802–1805 on its alloy with platinum. Mr. Cloud's paper on the Brazilian alloy of palladium was read before the American Philosophical Society, June 23, 1809, and is printed in the sixth volume of their Transactions, p. 497. This appears to be the earliest research of the kind made in this country. Mr. Cloud followed up the subject by an investigation into the platinum metals, and it is said (*Bruce's Journ.*, p. 43) that he obtained rhodium of remarkable purity, but his paper, if printed, has escaped my search.

William James Macnevin, M.D.—Dr. Macnevin was made Professor of Chemistry in the College of Physicians and Surgeons in New York in 1811. He was educated in Germany, receiving the degree of M.D. in Vienna in 1783, at the age of twenty years. There is a romantic interest connected with the political side of his career as one of the Irish patriots associated with Emmet, Fitzgerald, Tone, etc., with which we now have no concern. In 1826, he was one of the associates with Dr. Francis, Dr. John Griscom, and others in founding the Rutgers Medical College, and taught Materia Medica in addition to Chemistry. Dr. Macnevin published "An Exposition of the Atomic Theory," which was favorably received both in this country and in Europe. Besides editing an edition of Brande's Chemistry, he was also coeditor of the *New York Medical and Philosophical Journal*. His scientific papers, so far as recorded, are:—

Decomposition of Potash. *Am. Med. and Phil. Journ.*, ii. 204–208, 1811.

Chemical Examination of the Waters of Schooley's Mountain. *N. Y. Lit. and Phil. Trans.*, i. 540–557, 1815.

Analyse Eines Krystallisirter Dolomit aus Nord Amerika. *Schweigg, Journ.*, xxx. 89–94, 1820.

Exposition of the Atomic Theory of Chemistry and the Doctrine of Definite Proportions. *Thomson, Ann. Phil.*, xvi. 1820.

Chemische Unterschungen über eine neue art Baryt, den Schoharit. *Schweigg. Journ.*, xxxii. He died July 12, 1841, aged 78 years.

John Gorham, M.D.—Prof. Gorham was the Erving Professor of Chemistry at Harvard University from 1816 to his death in 1827. His one great and lasting contribution to our science was his systematic treatise, published in 1819, in two volumes, 8vo., embracing about eleven hundred pages, under the title of "The Elements of Chemical Science." This work bears ample testimony that the author was a man of ability and thoroughly familiar with his science. His "introduction" is an essay which every chemist to-day can read with pleasure and admire for its truly wide philosophic spirit as well as for its chaste and beautiful style. The whole treatise is, for the time, an admirable performance, and fully justifies the opinion then expressed of it by Prof. Silliman in his notice of the work (*Silliman's Journal*, 1822), that "this work is not surpassed by any one with which we are acquainted, as a perspicuous, chaste, and philosophical treatise." Dr. Gorham had been the fellow-student of Prof. Silliman under Dr. Hope in Edinburgh, in 1804–5.

Dr. Gorham's "Elements" was the first systematic treatise on the science of chemistry by an American author, and deservedly secures honorable mention to his name. His chemical papers appear to have been few. "An Analysis of Heavy Spar from Hatfield" (1815); "Contributions to Chemistry, No. 1;" "Indigogene" (*N. E. Journ. Med.*, vi. 1817); "Chemical Examination of Sugar, supposed Intentionally Poisoned" (*Thomson's Am. Phil.*, 1817, x. 197); "Chemical Analysis of Indian Corn" (*N. E. Journ. Med.*, ix. 1820; *Tilloch's Mag.*, lvii. 1821, 311); and "Examination of Calculi from the Sublingual Gland" (*N. E. Journ. Med.*, ix. 1820), are all I find mention of.

One of his pupils, whose own professional eminence gives weight to his words, in a private communication to the speaker, under date of July 27, 1874, says: "Dr. Gorham, who succeeded Dexter in the Chemical Chair (at Harvard), was an accomplished teacher, and exceedingly popular with all the students. The excellent treatise, to which you allude, was written for our benefit, and considered by us all as the sure guide to all the arcana of science, and the book of books, which no future discoveries could ever suffer to be laid upon the shelf as a thing of the past."

"Dr. Gorham died young, for the interests of science and the love of his professional brethren, who followed him as true mourners to an early grave."

Parker Cleaveland.—From 1803 until his death Prof. Cleaveland devoted his life with remarkable singleness of purpose and exclusive assiduity to the duties of his professorship at Bowdoin College, Maine. He at first did all the work there in mathematics, natural philosophy, chemistry, and mineralogy. He was relieved of mathematics by another colleague after some years. His name is inseparable from the early history of American science. Although a good chemist, and during his long life its successful teacher at Bowdoin, his fame rests chiefly and securely on his "Elementary Treatise on Mineralogy," which first appeared in 1816, and in a second revised edition in 1822. The *Edinburgh Review* for September, 1818, at a time when they were not much given to praising American books, said of Prof. Cleaveland's "Mineralogy," "that it would be found to be the most useful work on mineralogy in our language," and advises its republication in Great Britain.

There can be no doubt that the timely appearance of Cleaveland's "Mineralogy" did very much to stimulate scientific progress in the United States, and it was certainly, at the date of its issue, the most important contribution made to American scientific literature. A careful review of it by Prof. Silliman in 1818, will be found in the first volume of the *American Journal of Science*.

James Freeman Dana.—The recognition of chemistry as an element of academic instruction at Dartmouth College in 1820, was signalized by the election of Dr. Dana as their first professor. He had been the assistant of Dr. Gorham at Harvard, where he graduated in 1813. He developed such ability in chemical studies, that in 1815, while yet in his novitiate under Dr. Gor-

ham, he was selected by the university to visit London, and procure for the chemical department at Harvard a new outfit of apparatus, which commission he executed to the complete satisfaction of the authorities. While in London he prosecuted his studies in practical chemistry in the laboratory of Accum, who also had been the instructor of Prof. Silliman in 1804–5, and who had at that time the only laboratory in London open to students. On his return to Cambridge he executed the needful repairs and alterations in the laboratory preparatory to receiving the new apparatus, and was almost immediately appointed assistant to the professor of chemistry.

In the autumn of 1817 he was appointed Lecturer on Chemistry at Dartmouth College, and in 1820 Professor of Chemistry and Mineralogy in the same institution. While yet a student at Cambridge, he received the award of the Boylston prize for a dissertation on the "Tests for Arsenic," and while on his voyage home from Europe he wrote a second dissertation on the "Composition of Oxymuriatic Acid," for which the Boylston premium was again assigned him in 1817. In all respects Dr. Dana was a man of superior qualities, and his brief career, cut short by an untimely death at thirty-three years, is marked by contributions to science of no ordinary merit. His most important original work was his "Epitome of Chemical Philosophy," Concord, New Hampshire, 1825, pp. 221. This treatise, in which he develops the philosophy of the science as it then existed, is an extended syllabus of the lectures delivered by Dr. Dana at Dartmouth College, and is altogether a creditable performance. He was an accomplished experimenter, skilful in devising apparatus and methods, and an eloquent, perspicuous lecturer.

He contributed original memoirs on a variety of subjects; for example:—

In 1819. On a New Form of Electrical Battery (which is a mode of Æpinus's condenser).

1819. "Chemical Examination of the Berries of Myrica Cerifera, or Wax Myrtle." He presents a proximate analysis of the berry.

1819. On the Effect of Vapor on Flame. This short paper has great significance, and the line of research it indicates has never yet been fully worked up.

1820. On the Existence of Cantharidin in the *Lytta Vittatæ*, or Potato Fly.

1822. "Chemical Examination of some Morbid Animal Products." In this paper Dr. Dana gives the results of his examination of a collection of urinary and other calculi in the Anatomical Museum of Harvard College. He detects the error of Brande in mistaking uric acid for muriatic acid in calculi, and shows his sagacity as an analyst by other evidence.

1823. Miscellaneous Notices: 1. Connection of Electricity, Heat, and Magnetism. 2. Preparation of Euchlorin Gas. 3. Concretion from the Tonsil.

1823. "Galvano-Magnetic Apparatus." This is a neat form of floating spiral, like Ritchie's, which was then unknown.

1824. "On the Theory of the Action of Nitrous Gas in Eudiometry." A creditable paper.

1824. "Ignition of Platinum," by Vapor of Ether on Warm Platinum Sponge. "New Locality of Cobalt." This was the "Danaite" or cobaltine of Fredonia, N. H., first noticed by Dr. Dana. Mr. Patten's Air-Pump. All the above in *Silliman's Journal.*

1827. Some Experiments on the Root of *Sanguinaria Canadensis* (*N. Y. Lyc. Nat. Hist.*, ii. 1828, 225). Dr. Dana discovered the alkaloid which he called *sanguinarine*, in the roots of this plant. Dr. A. A. Hayes, then assistant to Dr. Dana, had previously called the attention of his instructor to this plant. See *Silliman's Elements of Chemistry*, ii. 1831, pp. 503–505, for a statement of the case by Hayes. Dr. James Schiel, of St. Louis, has subsequently demonstrated the identity of sanguinarin with chelerythrine (*Sill. Journ.* [2], xx. 220, 1855. See *Gmelin's Hand-Book*, xvii. 156).

SAMUEL LUTHUR DANA, M.D., born 1795, died 1868. —Dr. Dana, of Lowell, was for fifty years the acknowledged authority in the United States as a technical chemist. After completing his medical studies in 1818, he soon devoted himself exclusively to manufacturing and technical chemistry, holding the position of chemist to the Merrimac print works in Lowell, Mass., from 1833 to the time of his death, thirty-five years. He is the inventor of what is known as the "American System" of bleaching, which he made known in 1838, in the Bulletin of the Société Industrielle de Mulhouse. By his researches upon the action of cow dung as a mordant, he discovered that this and similar manures acted by virtue of the phosphate of sodium they contain, and led to the use of dung substitutes, independently by Dana in the United States, and by Mercer in England. These researches upon cow dung also led him to investigate the nature of manures in general, of mould and muck, and finally to write his well-known book called "A Muck Manual for Farmers" and an essay on manures which received the prize of the Massachusetts Society for Promoting Agriculture. Dr. Dana, in point of time, originality, and ability, stood deservedly first among scientific writers on agriculture in the United States.

Dr. Dana published a translation of "Tanquerel on Lead Diseases" (translated chiefly by his daughters), his attention having been drawn to the importance of the subject by his researches upon the action of the waters of Lowell upon lead, undertaken by him at the request of the government of that city.

Dr. Dana was a man of a retiring, modest disposition, and he published but little, although the ample stores of his knowledge were always open to those who sought his advice.

JOHN GRISCOM.—Dr. Griscom was one of the earliest teachers of chemistry in the United States, commencing as a private lecturer in 1806, in New York. Dr. Francis, who was subsequently his colleague in Rutgers Medical College, says, "for thirty years Dr. Griscom was the acknowledged head of all other teachers of chemistry among us" (in New York), "and he kept pace with the flood of light which Davy, Murray, Gay-Lussac, and Thénard and others shed on the progress of chemical philosophy at that day. His calm spirit, his deliberate and grave utterance, his exact diction, the simplicity of his manner, and his unostentatious life, were the characteristics which marked him."

Dr. Griscom contributed for many years abstracts of chemical papers from the foreign journals to the *American Journal of Science*, a service which he performed with habitual exactness. But I do not find record of any original researches by Dr. Griscom, whose activities were consumed chiefly in the duties of instruction, and in various philanthropic labors, to which he devoted himself with much zeal and success.

Prof. Silliman maintained a lifelong correspondence with Dr. Griscom, and in one of his letters written January 15th, 1850, says, in allusion to Dr. Griscom's contributions to the *American Journal of Science*, "but nothing in the miscellaneous department can ever

rival those rich contributions which you made with so much punctuality and judicious selection."

Thomas Cooper.—Dr. Cooper was among the early workers in chemistry in this country. He was a voluminous writer on a variety of subjects, political, ethical, economical, philosophical, and chemical. He filled the chemical chair at Dickinson College, in Carlisle, Pennsylvania, from 1811 to 1814, and after this at Columbia, South Carolina, from 1819 to 1834, where he became President of the University.

Dr. Cooper, in 1811, published in *Bruce's Journal*, pp. 134–139, an "Account of the Decomposition of Potash and Production of Potassium by Heat," accompanied by a plate, showing the apparatus he used. This was done in Priestley's laboratory, at Northumberland, and is the first account we have of the production of potassium in this country by the furnace process. In 1818 Dr. Cooper edited in Philadelphia an edition of Thomas Thomson's System of Chemistry, in 4 vols. 8vo.; and in the same year he published a work on Medical Jurisprudence. He had learned in France the secret of making chlorine from common salt, and attempted to turn bleacher and calico printer at Manchester, but was not successful. His radical politics led him to follow his friend Priestley to America, and he took up his residence at Northumberland as a lawyer, prior to assuming the duties of the chemical chair at Carlisle. He was a free-thinking materialist, and commonly accredited an unbeliever. He died May 11th, 1840, aged 81 years.

Thomas G. Clemson, of Pennsylvania, was one of the small number of Americans educated at the School of Mines in Paris. He is the author of some mineral analyses, and proposed the name *seybertite* for the so-called bronzite, or clintonite of Amity, which he carefully analyzed, and both the name and analysis stand good to-day. Mr. Clemson was, I believe, the first to announce the discovery of the diamond in North Carolina, where he resided from an early period after his return from Europe. If he made later researches, I have failed to find the record of them.

Dr. John Redman Coxe, who in 1809 succeeded Dr. Woodhouse in the medical department of the University of Pennsylvania, has left us some records of his original researches. We may mention especially his paper in *Thomson's Annals of Philosophy*, in 1816, on a Plan for Electric Telegraphy, which long antedates any other American suggestion on this subject since the days of Franklin. Dr. Coxe also wrote on Phosphorus (*Thomson's Ann. Phil.*, 1813, i. 68); Observations on Crystallization (*Ibid.*, 1815, vi. 101–106); On Lead Pipes (*Ibid.*, 1816, viii. 237); Preparation of Phosphuret of Lime (*Journal Royal Instit.*, i. 1831, 172).

William Charles Wells, M.D., F.R.S., the author of the "Essay on Dew," crowned by the Royal Society of London, in 1814, with the Rumford medal, was an American, born in Charleston, South Carolina, in 1747. Few physical investigations can be found on the fair pages of science, undertaken in a purer spirit of research for truth's sake than those which this lonely, austere, and abstemious man carried out in his garden in Surrey, in 1812. His apparatus was of the simplest. With a few small thermometers, some plates of different kinds of metal, a few watch glasses, and small pledgets of swan's down and wool, on the greensward of his little garden in Surrey, during the livelong nights, with the silent stars his only companions, did this philosopher meekly and reverently enter the great temple of nature, an earnest seeker of her secrets—a humble worshipper at her shrine. There he evolved, by patient inductive research, those laws now seemingly so self-evident, which, from the days of Aristotle, had eluded the grasp of previous observers. "Few and simple as were the means with which Dr. Wells conducted his researches, his experiments were so various, so direct, and so conclusive—so sagaciously devised and so admirably executed—that the whole philosophy and economy of the subject which he studied were completely settled."* The simplicity of his recital of his experiences, in his life, is worthy of his earnest devotion to his work while suffering under the distressing disease which in a few years terminated his hard and checkered career.

There is a chastened intellectual joy which flows into the soul, from the contemplation of any ideally perfect work of research like this, which has stood the test of time, and stands now, as it were, a life for a life. It seems like the sea-shell softly to murmur of its parentage, and, as Landor says of the shell—

> "Pleased, it remembers its august abodes,
> And murmurs as the ocean murmurs there."

[Professor Tyndall, in his late address, August 19, 1874, at Belfast, which comes to hand as this is passing the press, says: "In 1813 Dr. Wells, the founder of our present theory of dew, read before the Royal Society a paper in which, to use the words of Mr. Darwin, 'he distinctly recognizes the principle of natural selection; and this is the first recognition that has been indicated.' The thoroughness and skill with which Dr. Wells pursued his work, and the obvious independence of his character, rendered him long ago a favorite with me; and it gave me the liveliest pleasure to alight upon this additional testimony to his penetration."]

James Cutbush was the Professor of Chemistry at the U. S. Military Academy at West Point, and previously at St. John's College, Maryland. His paper "On the Formation of Cyanogen in some Chemical Processes not before noticed" (*Sill. Journ.*, 1822, vol. vi. pp. 149–155) describes the production of cyanogen from the action of nitric acid upon charcoal. He published an elaborate essay "On the Composition and Properties of the Chinese Fire and the so-called Brilliant Fires" in the seventh volume of the *Am. Journ. of Sci.*, pp. 118–140, with numerous pyrotechnic formulæ; and another article in the previous volume (vi. 302), "On the Composition and Properties of Greek Fire," which is full of curious learning. In the Memoirs of the Columbian Chemical Society of Philadelphia, of which society Dr. Cutbush was the president, is a short paper by him "On the Oxyacetate of Iron as a Test or Reagent for the discovery of Arsenic" (1812).

Julius T. Ducatel.—Dr. Ducatel, of Baltimore (born June 6th, 1796, died September 23d, 1849), was the Professor of Chemistry in the University of Maryland, and in 1830 was elected, on the death of Dr. De Butts, to the chemical chair in the medical department of the same university. Dr. Ducatel enjoyed the repute of being an accomplished and successful teacher and lecturer on his science. He had enjoyed in Paris the teachings of Brougniart, Brochant, and Gay-Lussac, with whom he ever maintained a correspondence. His only chemical contribution of which record is preserved, was his "Manual of Toxicology."

Lardner Vanuxem.—One of a small number of Americans who early enjoyed the advantages of a sci-

* From an eloquent tribute to the life and character of Dr. Wells, by Dr. Elisha Bartlett, 1849.

entific training at the School of Mines in Paris, and the associate of Brougniart, Haüy, and other distinguished men, Vanuxem early contributed important chemical and physical memoirs upon American mineralogy, often in company with his friend Keating. These papers are mostly to be found in the *Proceedings of the Academy of Natural Sciences of Philadelphia.* His analyses of phosphate of iron from New Jersey; of tabular spar from Willsborough; of jeffersonite; of zircon, from Buncombe, North Carolina; of marmolite, and other serpentines, are not merely good analyses, but show their author to have had a thorough scientific training. The paper on the "Mineralogy of Sussex County, New Jersey," in connection with Keating (1822) is an admirably prepared memoir. Prof. Vanuxem was for a time in charge of the chemical instruction in the University of South Carolina, at Columbia, South Carolina, under Dr. Thomas Cooper's presidency. He later had charge of one of the divisions of the New York State geological survey, one volume of the final reports being devoted to the record of his labors. He was deservedly held in the highest esteem for his earnest simplicity and steady integrity of character. He died in 1848.

The University of Virginia has been fortunate in its chemical professors. Dr. J. P. Emmett was the first, from 1825, until his death in 1842. He was succeeded by Prof. Robert E. Rogers, who filled the chair until 1852, when it fell to Dr. J. Lawrence Smith, who was followed by Dr. S. Maupin, and he again by the present incumbent, Prof. J. W. Mallet.

John Patton Emmet, M.D.—Dr. Emmet was the Professor of Chemistry from 1824, until his death in 1842, at the University of Virginia. He contributed important memoirs upon both chemistry and physics. His papers "On Iodide of Potassium as a Test for Arsenic," "Upon the Solvent and Oxidating Powers of Ammoniacal Salts," "Bromine and Iodine in Kanawha Salts," "On Formic Acid," and "On the Solidification of Raw Gypsum," were all published in the *American Journal of Science*, where also he was a frequent contributor of papers on electro-magnetism and magneto-electricity, which showed originality and research. His method of evolving sparks and shocks from the common magnet was ingenious and original, and among the very earliest observations in magneto-electricity. I learn from Dr. J. Lawrence Smith that Dr. Emmet left valuable and extended notes of original experiments on light and other subjects, which have not yet been published.

John Torrey, of New York, for more than half a century deservedly esteemed for his exact attainment in science, and for every virtue, although one of the best read chemists and most successful chemical instructors in the United States, has left few records of his work to which reference can be made. He filled successively the Chemical Chairs at West Point; in the College of Physicians and Surgeons in New York; and at Nassau Hall, in Princeton; and for many years was at the head of the chemical department of the United States Assay Office in New York. His most important contributions to science were in the department of mineralogy and botany. His name is inseparably connected with the development of the North American flora. His fine botanical collections are now, by his gift, the property of Columbia College in New York, of which institution he was for many years a trustee.

Dr. Torrey in 1819 discovered that the remarkable fungus found underground in Virginia and elsewhere, and known as *tuckahoe*, or Indian-bread (*sclerotium gigantium*), was composed entirely of a new principle, not before described, and which he called *sclerotin*. Dr. Torrey's original paper on this subject was read before the New York Lyceum of Natural History in 1819, and was published in the *New York Medical Repository* for December, 1820. In 1827, after the publication of Braconnot's paper on *Pectic Acid* (in 1824, *Ann. de Ch. Phys.*, 28, 173; 30, 96). Dr. Torrey republished his earlier paper, with some additions in the *New York Medical and Physical Journal* (vi. No. 4), and showed the identity of the two substances. See *Silliman's Journal*, 2, xxvii. 439, for further remarks on pectic acid, and Dr. Torrey's original discovery of it.

Sketches of the scientific labors and services of Dr. Torrey will be found also in vol. v. *American Journal of Science*, 1873, pp. 324 and 411.

Dr. Torrey published in the *New York Lyceum of Natural History*:—

1824. On Yenite in the United States, p. 51, vol. i.
1824. Account of the Columbite of Haddam, i. pp. 89-93.
1836. Notes on American Minerals, vol. iii. p. 86.
1825. Vauquelinite in the United States.
1848. Vauquelinite in the United States, vol. iv. pp. 76-79.

In the *American Journal of Science and Arts*:—

1818. On Staurotide, vol. i. p. 435.
1820. On Siderographite, vol. ii. p. 176.
1822. On an ore of Zinc at Ancram, vol. v. 235.
1825. On West Point Minerals, vol. ix. p. 402.
1839. On the Condensation of Carbonic, Sulphurous, and Chlorochromic Acid Gases, vols. xxxv. 374 and xxxvi. 394.

Samuel Guthrie, M.D.—Dr. Guthrie, of Sackett's Harbor, New York, deserves honorable mention as one of the earliest laborers in practical chemistry in this country. He was an original discoverer of chloroform, quite independently of the contemporaneous researches of Soubeiran, Liebig, and Dumas—made at the same time, but completely unknown to Guthrie. I have elsewhere recited the main facts of this curious piece of chemical history, and may be permitted to quote it here.*

"So early as 1796, an association of four Dutch chemists, who had already discovered the rich hydrocarbon gas, long known as heavy carburetted hydrogen gas, or olefiant gas, and now called ethylene or hydrogen-dicarbide (C_2H_4), studied the effects produced from mingling this hydrocarbon with an equal volume of chlorine gas over water. They saw that the volume of the mixed gases rapidly diminished, with a notable elevation of temperature and the appearance of a dense oily-looking liquid, collecting on the sides of the bell-jar and the surface of the water, and quickly sinking to the bottom. Collecting this oily liquid and washing it clean of adhering chlorine, in alkaline water, and in pure water, it was found to be a new substance of a highly agreeable ethereal odor, and distinctly sweetish aromatic taste, neutral to tests, and nearly insoluble in water, to which, however, it imparted its taste and odor, but quite soluble in ether and alcohol. It was wholly unaffected by concentrated sulphuric acid even with the aid of heat.

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* "A Century of Medicine and Chemistry:" A Lecture Introductory to the Course of Lectures to the Medical Class in Yale College, 1871.

For many years its real constitution remained unknown, and it was shown only as one of the curiosities of the chemist's laboratory, under the name of 'Oil of the Dutch Chemists;' the name olefiant gas having had its origin from the oil-producing property, which this gas developed in its action with chlorine. Analysis has long since shown that this chlorine compound of the Dutch chemists is a simple union of one molecule of ethylene with two of chlorine, and that it may properly be called the chloride of olefiant gas. I have been the more particular in noticing the discovery of this remarkable substance because it has acquired considerable notoriety from the fact that it was early and most naturally confounded with chloroform, to which, in sensible and physiological properties, it bears a remarkable resemblance. It was long known as 'Chloric Ether,' a name which conveys a false meaning, since there is nothing in the chemical constitution of the body which in the least resembles the ethers.

"In 1831 appeared the second volume of 'Silliman's Elements of Chemistry,' in the order of the lectures then given in Yale College, in which the Dutch liquid was spoken of in its physiological relations, with the remark that, 'Its medical powers have not been ascertained, but from its constitution and properties it is highly probable it would be an active diffusive stimulant.'

"This remark immediately attracted the attention of Dr. Samuel Guthrie, of Sackett's Harbor, New York, a man of an active and original mind, much devoted to practical chemistry, who at once conceived that he might obtain the so-called 'chloric ether' in greater abundance and at a cheaper cost by distilling together alcohol and chloride of lime (bleaching powder). His success was remarkable, and he obtained the alcoholic solution (of chloroform) in great abundance, describing his process in a short article in *Silliman's Journal of Science* for January, 1832; and subsequently, in July of the same year, he states with more detail the precautions he adopted to obtain the product pure, and especially, free from alcohol. It is remarkable that in his second paper he describes in full the method of testing the purity of the substance by agitation with concentrated sulphuric acid. There is no question that Dr. Guthrie was entirely original in his method of producing 'chloric ether,' as it was then called, and it is no abatement of his sagacity that he was not aware that, earlier in the same year in which he described his process, a French chemist, Mr. Soubeiran, had devised and described the same method in a memoir entitled, '*Researches on some Combinations of Chlorine*,' which appeared in the *Ann. de Chemie et de Phys.* for Feb. 1831. Soubeiran calls the product 'a new ethereal liquid of a constitution unlike any before known to chemists,' and also gives us the name chloric ether (*ether chlorique*). The term 'chloric ether' had also been used by Dr. Thomson in 1820 to describe the oil of the Dutch Chemists. Soubeiran gave two analyses of this product, which, while they prove that the body is not the 'Dutch liquid,' failed to reveal its true constitution, which was first given by Dumas in 1834, in a memoir published by him in the same journal, and in this paper Dumas then gave to the new body the name by which it has ever after been known, *chloroform*.

"Such, in brief, is the history of one of the most remarkable bodies ever discovered. You will understand that while the 'chloric ether' of Guthrie was a misnomer, the substance which he produced was *chloroform*, and that the first use made of this agent in medical practice was at the suggestion of Prof. Silliman, to Dr. Eli Ives, formerly Professor of Theory and Practice in this college in 1832. Dr. Ives's note on his experience will be found in *Silliman's Journal*, vol. 21, for July, 1832. The case in which he employed it was one of asthma in an aged person, who was relieved of a severe paroxysm by its use 'more suddenly than she had been in any previous illness of the kind.' Thus the therapeutic history of chloroform had its commencement from the teachings and practice of the Yale Medical School."

The question of absolute priority of the discovery of chloroform may give it to the French chemists Souberaine, but a committee of the Medico-Chirurgical Society, of Edinburgh, have awarded to Dr. Guthrie the merit of having first published an account of its therapeutic effects as a diffusible stimulant in 1832. Chloroform is, therefore, fairly to be claimed as an American discovery. Guthrie also experimented with a boldness and intrepidity amounting almost to rashness in the preparation of fulminating compounds, of which he manufactured large quantities, of various and original constitution, for commercial purposes. His papers on this subject in vol. xxi. (1832) of the *American Journal of Science* disclose his power as an originator of new methods in chemistry. This is true, also, of his process for the rapid conversion of potato-starch into sugar, printed in the same volume.

George T. Bowen, whose early death, in 1828, at Nashville, where he had just assumed the duties of the chemical chair in the University of Nashville, deprived chemical science of a zealous votary. Such was his devotion to chemistry that, while an undergraduate at Yale College, he was permitted, contrary to all precedent in those days, to devote all the time he could spare from his other studies to laboratory work, under the instruction of Prof. Silliman. Here he made original observations (1822) "On the Electro-magnetic Effects of Hare's Calorimeter," and "On a Mode of Preserving in a Permanent Form the Coloring Matter of the Purple Cabbage as a Test for Acids and Alkalies." He has left us analyses and descriptions of several minerals, *e. g.*, of the scheelite of Lane's mine; of Sillimanite, which he proposed as a new species; of the silicate of copper from New Jersey; of a variety of serpentine which he called nephrite, from Smithfield, Rhode Island; and of pyroxene-sahlite from near New Haven. All this he did chiefly before 1822, and prior to commencing his medical studies in Philadelphia, where also he was a devoted follower of the meetings of the Academy of Natural Sciences, contributing to their memoirs and discussions. Dr. Bowen was born at Providence, Rhode Island, March 19th, 1803, graduated at Yale College in 1822, was elected Professor of Chemistry at Nashville in 1825, where he died October 25th, 1828, in the 26th year of his age.

Dr. Gerard Troost succeeded Dr. Bowen in the chemical chair of Nashville University in 1828, where he served as Professor of Chemistry, Geology, and Mineralogy until his death in 1850. Dr. Troost was a native of Bois le Duc, in Holland (born March 15th, 1776). He was educated at Amsterdam and Leyden, studying medicine and chemistry. Having great skill in crystallography, he was in 1807 sent to Paris by Louis Bonaparte, to pursue his favorite studies under the renowned French mineralogist Abbé Haüy. In 1810 he came to America and settled at Philadelphia, where he was one of the founders, and the first President of the Academy of Natural Sciences. He was a constant contributor to the early volumes of the Transactions of the Academy. His papers were chiefly mineralogical,

and especially crystallographical. His paper on Pyroxene, in the *Annals of the Maclurean Lyceum*, is a valuable contribution.

In 1814 Dr. Troost established works for the production of alum at Cape Sable, Maryland, which was one of the earliest chemical industries in this country, and, if I mistake not, the first manufactory of alum.

To his well-directed zeal and industry science owes much for its progress west of the Alleghanies. He instituted the geological survey of Tennessee, and for eighteen years was the geologist of that State, carrying on his work of exploration under many discouragements, and almost unrequited, until his death on the 14th of August, 1850.

He added largely to our knowledge of meteoric bodies, having been fortunate in collecting a great number of both stony and iron masses, fallen or found in his immediate vicinity, and the chemical and physical history of which he accurately studied. His memoirs on these bodies will be found in the *Amer. Journ. of Sci.* With surprising industry and success, considering his remote and comparatively isolated situation, he amassed one of the most valuable collection of minerals and fossils ever formed in the United States, sparing neither labor nor expense to this end. Fortunately his collection escaped unharmed the ravages of war, thanks to the timely care and skill of one of Dr. Troost's sons, and of Dr. J. B. Lindsley, President of Nashville University, although his valuable scientific library was scattered and destroyed. The catalogue of Dr. Troost's mineral collections forms two stout manuscript volumes, written in the clear hand of the author, and describes 13,582 numbered and ticketed specimens, with their crystallographic and physical characters carefully distinguished. This collection, together with the fossils (which are also very valuable), has lately been secured to the Public Library of Louisville, Kentucky, chiefly by the exertions of Dr. J. Lawrence Smith, at a cost of $20,000. This collection is especially rich in crystallized specimens and varied forms, to the study of which Dr. Troost devoted special attention. The catalogue, we are informed, is to be printed in detail. A sketch of the life of Dr. Troost, by Dr. Philip Lindsley, will be found in vol. i. p. 539 of the works of the latter.

DENISON OLMSTED.—Although Prof. Olmsted's fame rests upon his astronomical and more especially upon his meteorological studies, and his discussion of the great meteoric shower of 1833, yet we remember with satisfaction that he was also a chemist. From 1817 to 1825 he filled the chair of chemistry in the University of North Carolina, where he signalized his term of duty by inaugurating and carrying forward, gratuitously, the first attempt ever made in the United States toward a geological survey of a State. His report, in two parts, appeared in 1824 and 1825, filling only about 140 octavo pages. He also read before the Connecticut Academy, in 1826, after his transfer to the physical chair at Yale College, a "Memoir on the State of Chemical Science," which may be read now with curious interest, as a record of the then existing state of philosophical opinion in our science. It may be found in the XIth and XIIth volumes of *Silliman's Journal.* It is noteworthy that no similar attempt has since been made by any American chemist, until Dr. Gibbs's Report on the Recent Progress of Organic Chemistry (*Proceed. Amer. Ass.*, ix. pp. 37–61, 1855).

Considering the rudimentary state of geology and its associate sciences in 1821, Prof. Olmsted's labors as the pioneer in this department of exploration must ever be considered as eminently honourable to his scientific grasp and ability.

DENISON OLMSTED, JR.—This promising chemist, son of the former, died at the early age of twenty-two years, in 1846. He had been for two or three years before an assiduous student in the laboratory of Yale College, where the writer had the happiness to count him as one of the earliest of his pupils in the incipiency of the "Yale Scientific School." His analytical work during that period will be found on record. For a year before his death he held the post of chemist to the geological survey of Vermont, and he was honored shortly before his death by an appointment to a similar situation in Canada, to which our distinguished colleague Dr. Hunt, also taken from the Yale Analytical Laboratory, succeeded. His mineralogical cabinet, gathered by himself, now forms the nucleus of the collection in Beloit College.

W. W. MATHER.—Prof. Mather, who died, acting President of the University of Ohio, at Columbus, is better known to this generation as the author of the Report on the First District, in the Geological Survey of New York (1843), than as a chemist. But, if we turn to the 27th volume of the *American Journal of Science* for 1835, pp. 241–267, we shall find an elaborate memoir entitled "Contributions to Chemical Science by W. W. Mather, Assist. Prof. of Chemistry at the U. S. Military Academy, West Point."

This memoir is upon—I. Chloride of Aluminium and its Analysis. II. Hydrated Chloride of Aluminium. III. Crystallized Tin from Solution. IV. Georgia Gold. V. Silver of Lane's Mine. VI. Iodide of Potassium and Platinum, or Iodo-platinate of Potassium. VII. Chloriodide of Platinum. VIII. Crystallized Perchloride of Platinum. IX. Amalgam of Platinum. X. Iodide of Mercury. XI. Solubility of Bitungstate of Ammonia. XII. Disulphuret of Bismuth.

An examination of this memoir will show that it is the work of a chemist of unusual ability. The author presents a great number of analyses by himself made with much care, and details all his processes. He gives a new determination for the atomic weight of aluminium, prompted to it by a discrepant statement in Berzelius (*Traité de Ch.*, ii. 373) by which the numbers representing the composition of alumina are transposed. The whole paper is a creditable one, and up to its date was the most elaborate original research in inorganic chemistry which had been made by any American chemist, so far as I have seen.

Prof. Mather also contributed papers "On the principles involved in the reduction of iron and silver ores, with a suplementary notice of some of the principal silver mines of Mexico and South America" (*Sill. Journ.*, 1, xxiv. 1833, pp. 213–237). In this elaborate memoir the author discusses the chemistry of the Mexican silver processes, before that time almost completely unknown in this country. His paper contains a great amount of useful information.

"On cupellation, an easy, an accurate, and new method" (*Sill. Journ.*, 1. xxxv. 321, 1839).

"On the crystalline form of iodine," with figures (*Sill. Journ.*, 2, xviii. p. 35, 1830).

GEORGE C. SCHAEFFER.—Prof. Schaeffer, who died in 1873, at Washington, was long justly esteemed as one of the best read chemists of his time. He published but little, but the student of American chemistry will find in his papers "On perchromic acid:" "On the manufacture of ice;" his "New test for nitrates and nitrites," and "On the origin of nitrates," evidence of

his original power. He adopted what are now the accepted views in chemical philosophy long in advance of the great majority of chemists everywhere.

Nor can we forget his "Chemical abstracts," which for several years he supplied to the *American Journal of Science*, during the first decade of its second series, over the familiar initials of G. C. S.

Prof. Schaeffer for a time filled the chair of chemistry in the College at Danville, Ky. But the duties of instruction were less congenial to his tastes than the more quiet pursuits of original study, and he soon retired to the librarianship of the U. S. Patent Office, where he was in his element, and where he remained until his death, always honored and esteemed as a man of varied and exact learning.

All his memoirs here cited are to be found in the *American Journal of Science and Arts*.

LEWIS C. BECK.—Dr. Beck filled the chair of chemistry in Rutgers College, New Jersey, and at the Albany Medical College. His industrious habits and great devotion to science enabled him amid the constant drag of routine duty to make important contributions to science, in botany, medicine, and chemistry. His most important work was his "Mineralogy of New York" (1842) forming one of the quarto volumes of the Reports on the Geological Survey of the State. In this work occur many chemical analyses of minerals, mineral waters, and the like, made by the author, as well as of hydraulic limestones and other economic products. He was also an early contributor to general chemistry, and published, in 1827, "General views on the formation of phosphuretted hydrogen;" in 1828, "On the nature of bleaching and disinfecting compounds;" "On the functions of nitrogen in respiration;" "On the commercial potashes of New York;" "On wines and other fermented liquors;" and "On adulterations of various substances used in medicine and the arts," etc. At the request of Prof. Henry, Dr. Beck commenced in 1848 a laborious series of "Researches on the breadstuffs of the United States," afterwards published as a report by the United States Patent Office, at Washington.

He was a man of retiring habits, great modesty, and his personal character was such as to gain him numerous and attached friends. He died in April, 1853, in his fifty-fifth year. Dr. Beck was the author of "A Manual of Chemistry" (1831), which passed through four editions.

J. W. BAILEY.—The untimely death of Prof. Bailey deprived American science of one of her most devoted and successful workers in the fulness of his powers. Prof. Bailey was a chemist who, in the discharge of the duties of the chemical chair in the United States Military Academy at West Point, New York, gave good evidence of his ability, both as a teacher and investigator; although his devotion to microscopical researches, with such eminent success, has almost led us to overlook his earlier contributions to our science. Thus, for example, his tests for nitric acid, the double cyanide and iodide of mercury, and for sulphur by Playfair's nitro-prusside when used indirectly to detect sulphur in bodies like albumen, horn, hair, feathers, mustard-seed, etc. His paper "On the Common Blowpipe," and his note on the curious effects of a current of air on the flame of lamps, are evidences of his tact and neatness in chemical manipulation. His papers on the non-existence of polarizing silica in the organic kingdoms, and especially his beautiful researches in 1843 "On the crystals which occur spontaneously found in the tissues of plants" (*Sill. Journ.*, 1, xlviii. pp. 17–32, with a plate, 1845) are fine examples of micro-chemistry, and are characterized by a neatness which is found in all the work of this eminent and lamented investigator, and fully illustrated by his own pencil, which he held with great skill. A sketch of Prof. Bailey's life and scientific labors, by Dr. A. A. Gould, will be found in the *American Journ. of Science*, 2, xxv. p. 133, 1858. He died February 27, 1857, at the age of forty-six years.

ALEXANDER DALLAS BACHE.—Few probably of the younger chemists of this day look upon the late renowned chief of the United States Coast Survey as a chemist. But his encyclopædic knowledge embraced almost the entire circle of the sciences. He was chosen, only three years after his graduation at West Point, and when only twenty-two years of age, to the chair of Natural Philosophy and Chemistry in the University of Pennsylvania, at Philadelphia, which he held for seven years. During this time he published several chemical and chemico-physical articles, as that "On the Specific Heat of the Atoms of Bodies," in which he maintained that the best data then known (1828) failed to support the doctrine that the specific heat of atoms is the same for all bodies; and "On the Inflammation of Phosphorus in a Vacuum or Highly Rarefied Medium," 1830, a research he never fully completed. In 1832 he published a translation in *Silliman's Journal*, of the "Essay on Chemical Nomenclature Prefixed to the Treatise on Chemistry; by J. J. Berzelius," in which, as is well known to all students of the literature of our science, the distinguished chemist of Stockholm proposed the terminology which is now, after more than fifty years, come fully into vogue. In his paper entitled "Remarks on a Method proposed by Dr. Thomson for Determining the Proportions of Potassa and Soda in a Mixture of the Two Alkalies, with the Application of a Similar Investigation to a Different Method of Analysis," he generalizes the special case given, and shows that the principle to which these results refer themselves may be used with great effect in avoiding a difficult step in chemical analysis, by the substitution of a less direct but more simple one, aided by easy calculations, and well deserving the attention of analytical chemists (*Franklin Institute Journal*, 1836, xvii. pp. 305–309).

In molecular physics Prof. Bache's "Inquiry in Relation to the Alleged Influence of Color on the Radiation of Non-luminous Heat" (*Silliman's Journal*, 1836, 1, xxx. pp. 16–28), has become classic. It is almost needless to say that he proved by it the fallacy of the notion, till then commonly received, that color did influence the radiation of non-luminous heat. It is plain, that, had he not been called to a wider field of usefulness in the administration of great public trusts for science at Girard College, and later and chiefly of the Coast Survey, he could easily have obtained great prominence in chemical research.

WM. J. TAYLOR.—This chemist has left us a number of mineral analyses. He was a critical mineralogist and competent analyst. His most elaborate research was an extended memoir on Rock Guano, published in 1857 (*Proceedings of Academy of Natural Sciences*, and *Silliman's Journal*, xxiv. No. 71, pp. 177–188), with numerous exhaustive analyses, and copious references to the literature of the whole subject. He has also published an "Examination of the Meteoric Iron from Xiquipilco, Mexico," with minute analyses (*Silliman's Journal*, 1856, xxii. p. 374, and *Proceedings of the Academy of Natural Sciences*, Philadelphia, viii. No.

3): and has described lecontite, a new mineral species, a double sulphate of ammonia and soda with potash, containing two equivalents of water, and yet homomorphous with the group of anhydrous sulphates. Mr. Taylor, besides publishing other mineralogical notes, has translated Janoyer on the "Influence of Sulphur on Iron (*Silliman's Journal*, 2, xxiv. 330). We have to lament Mr. Taylor's early death.

J. E. Teschemacher of Boston is well remembered as an acute and exact scientist, expert especially in analytical chemistry and in the determination of mineral species, using the blowpipe with remarkable skill and facility. A full list of his scientific papers will be found in the *American Journal of Science*, vol. xvii. p. 294. 1854. more than thirty in number, mineralogical, chemical, and chiefly botanical. Mr. Teschemacher was all his life engrossed in commercial affairs, and made science his recreation, doing more good work than some who have command of all their time for science.

James Davenport Whelpley.—Dr. Whelpley contributed a remarkable paper to the philosophy of chemistry in 1845, entitled "Idea of an Atom, suggested by the Phenomena of Weight and Temperature" (*Silliman's Journal*, 1, xlviii. 352–368). This paper embodies views entirely original with the author, but in which he was partly anticipated by Faraday's paper in 1844, on the "Nature of Matter" (*Phil. Mag.*, February, 1844. p. 136). But Whelpley's paper anticipated the subsequent notions of Faraday as set forth in his "Thoughts on Ray Vibrations" (*Phil. Mag.*, May, 1846). A review of these opinions showing the priority of Whelpley's statements will be found in *Silliman's Journal*, 1846, 2, ii. 401. Dr. Whelpley is also the author of two remarkable "Letters on Philosophical Induction," and on "Philosophical Analogy," which discuss principles fundamental in scientific methods.

John Pitkin Norton, Professor of Scientific Agriculture in Yale College, was appointed to the place he filled so well in 1847. Cut off at the early age of thirty years he has yet left us the record of a well directed life, crowned with honorable distinction as an original investigator in chemistry. After spending two years in attending the lectures of Prof. Silliman, and in study and research in the analytical laboratory of B. Silliman, Jr., he went to Scotland, where, as the student of Prof. James F. W. Johnston, he won the prize of the Highland Society, of fifty guineas, for his comprehensive and able research upon the Oat; an investigation which led the way to the later researches of the same class in this country and in Europe. In Utrecht, under Mülder, he prosecuted his studies in agricultural and physiological chemistry, of which his memoir on the protein bodies of peas and almonds is in evidence. In 1847 he joined Prof. Silliman, Jr., as a colleague in the duties of the Analytical Laboratory of Yale College, which drew to its walls an increasing number of pupils, and soon developed into the "Yale Scientific School," now the "Sheffield Scientific School." Prof. Norton was an industrious author and published during his term of duty his "Elements of Scientific Agriculture," and edited with valuable notes and corrections, Stephen's "Book of the Farm," in two volumes. He wrote a memoir on the potato disease, and was a constant contributor to the *Albany Cultivator*, in a series of letters written both from Europe and after his return. These letters were always remarkable for sound judgment, thorough accuracy and fulness, and the lively style in which they were written.

Among the class of practical agriculturists and students who came up to attend Prof. Norton's first course of lectures on Scientific Agriculture, in January, 1848, were several young men, then unknown to fame, upon two of whom his mantle fell, and is now borne in the persons of Prof. William H. Brewer, and Prof. Samuel W. Johnson, of the Sheffield School, worthy successors in his own chosen field of study and authorship.

In the winter of 1851–52, Prof. Norton entered with zeal into the plan of establishing at Albany a university in which agriculture and its connected sciences should receive the direct patronage of the State. In carrying out this effort he was compelled to travel twice in each week during the winter from New Haven to Albany and back, giving three lectures in each place. This exertion proved too much for his powerful frame, and developed the latent seeds of pulmonary disease, which cut him down just as he had fairly entered on the wide field of his usefulness, perfectly fitted for the work, and enjoying the entire confidence alike of the agricultural community and of men of science. He was a man of noble generosity and the highest moral and scientific excellence.

Evan Pugh, Ph.D., F.C.S.*—Few American teachers of chemical science have attained a nobler fame than Dr. Evan Pugh, late President of the Agricultural College of Pennsylvania. A blacksmith's apprentice at the age of nineteen, he bought out the residue of his time and supported himself by manual labor while he received a year's instruction at the seminary of Whitestown, N. Y. He had fallen heir to a small estate, including a small academy, or private school, at Oxford, Chester County, Pennsylvania, his native place; and, removing thence, he conducted the school successfully for about two years. At this time Dr. Pugh manifested great interest in the educational reform which had lately commenced in Pennsylvania, and the manner in which he discussed the various subjects which engrossed the attention of the educators of that time, showed that he possessed in an eminent degree those logical and analytical qualities of mind which are characteristic of truly scientific men. He was an ardent advocate of phonetic spelling, and had himself attained great proficiency in the use of phonetic short-hand, a method of writing which he continued to employ, on account of its labor-saving qualities, for making notes, etc., throughout his life.

In 1853 he decided to sell his estate and academy, which had become under his management a flourishing institution, in order to obtain means by which he might secure for himself a European course of scientific instruction. His friends protested vigorously against this step, but he was not to be deterred; he went the same year to Europe and spent four years in the universities of Leipsic, Göttingen, and Heidelberg, and in Paris, a most diligent and successful student of natural and mathematical science. At Gottingen he honorably sustained the examinations for the degree of Doctor of Philosophy.

Although he seemed, while in Europe, to allow his course of studies to shape themselves by a sort of prescience, as it were, definitely towards his future career, he yet found time to study, as he had the capacity to master, the highest mathematics, besides making a number of chemical investigations of no slight import-

* This notice of Dr Pugh has been prepared by Mr W. S Waring.

ance, and which form the subjects of his principal published contributions to science, viz.:—

"Hämatinsalpetersäure identisch mit Pikraminsäure," *Journ. für Prakt. Chemie*, lxv. 362.

"Miscellaneous Chemical Analyses," Inaugural Dissertation, Göttingen, 1856.

"On a New Method of Estimating Nitric Acid," *Quart. Journ. Chem. Soc.*, xii. 35, and

"On the Sources of the Nitrogen of Vegetation, with special reference to the question whether plants assimilate Free or Uncombined Nitrogen," *Philosophical Transactions*, part ii., 1861, 146 pp., 4to., with plates.

This last-mentioned investigation was made in connection with Messrs. Lawes and Gilbert; but Dr. Pugh's share in the work was by no means the least. It appears that while in Paris Dr. Pugh addressed to Mr. J. B. Lawes, the distinguished English agriculturist, so well known by the numerous and valuable researches carried on at his estate of Rothamstead, a proposition to undertake a new investigation of the question, then so vigorously mooted in France between Boussingault and Ville, as to the assimilability of free nitrogen by vegetation. Mr. Lawes received this proposition favorably, and signified his willingness to have the research carried on in his laboratory and to defray all the costs, provided Dr. Pugh could satisfy him of his ability to estimate nitrogen with a certain degree of precision. Dr. Pugh repaired to Rothamstead, and his skilful application of volumetric methods satisfied Mr. Lawes.

The question which Dr. Pugh undertook to decide was one that had been raised more than half a century before by Priestley and Ingenhouse on the one hand, who thought they had observed that plants absorbed the free nitrogen of the atmosphere, and Sennebier and Woodhouse on the other hand, who negatived this opinion. In 1837 the subject was taken up again by Boussingault, who had the sagacity to apprehend the importance of closely investigating the sources of the nitrogen periodically yielded by a given area of land, over and above that which was artificially supplied to it. After a series of experiments extending over a period of 17 years, Boussingault concluded that plants did not assimilate free nitrogen. But it happened in the mean time that M. Georges Ville, of Paris, had, from a series of investigations made by him from 1849 to 1852. which seemed to show an enormous assimilation of nitrogen by the plants with which he experimented that could not be accounted for otherwise by him, announced that the free nitrogen of the atmosphere was assimilated by vegetation. Such strikingly different results at once excited great interest among chemists and vegetable physiologists, and a commission was appointed from the French Academy of Sciences to superintend the conducting, under M. Ville, of a new set of experiments at the Muséum d'Histoire Naturelle, in 1854–5. The report of this commission only tended to confirm the conclusions already drawn by M. Ville. Other experiments were made by MM. Cloez, Gratiolet, DeLuca, Harting, and Petzholdt, whose conclusions were nearly as conflicting as those of MM. Boussingault and Ville themselves.

The researches, however, which were instituted by Dr. Pugh, and to which he devoted two years of nearly constant labor, were characterized with such comprehensiveness in their details, skill and ingenuity in the construction of apparatus and cautions against error, and withal such a rare degree of penetration to discover the many collateral questions involved, and acuteness in their solution, that the conclusions which they established have never since been questioned.

Besides establishing the conclusions of M. Boussingault, these investigations supplied a great amount of evidence in relation to rotation of crops, etc. etc., of vast importance to agricultural science, and opened a rich field of inquiry in vegetable physiology which promised the most important results, had Dr. Pugh remained at Rothamstead to prosecute these researches.

But, while yet there, he received the offer of the presidential chair of the Agricultural College of Pennsylvania from its trustees, who had heard of the rare ability he had already evinced; and although Mr. Lawes, who not only admired his abilities, but was greatly attached to him in friendship, was anxious to retain Dr. Pugh in his laboratory at a handsome remuneration, and notwithstanding the latter was passionately fond of cultivating the fields of scientific research, he returned home in the autumn of 1859 to assume the position which had been offered him.

Willingly renouncing the brilliant career which he was doubtless aware lay before him in case he should continue his researches, he recognized the duty he owed his country, and assumed the nobler and more enduring work. It was a controlling idea with him, that the teacher lives a second generation in the mental developments of the taught, and that to be a benefactor to his race the student must be the medium through which he should operate upon the great world around him.

When Dr. Pugh assumed the presidency of the Pennsylvania Agricultural College, the expediency of combining manual labor with thorough study in an institution of learning was an open question, all previous attempts of the kind both in Europe and America having resulted in signal failures. He had, however, perfect faith in a system which he believed was calculated, above all others, to develop mental and physical strength as well as practical knowledge. Referring once to the well-known fact that it is not sufficient to have spent a certain number of years within the walls of a college or university in order to secure a respectable education, he said, "An English friend, himself a university graduate, once remarked to me that he could point to artisans in the workshops of England with better trained minds, as evinced by greater power of following up any connected train of thought, than could be found with many persons who had spent years at the time-honored universities of Oxford or Cambridge."

With the eyes of the friends of agricultural education in every civilized country resting upon the experiment, he had the courage to undertake to demonstrate its practicability. He had previously visited and carefully studied the chief agricultural academies and schools of Europe, and his idea of what an American agricultural college should be was as definite as it was comprehensive and just. He found the college a struggling institution, its buildings not half finished, and its exchequer awaiting the action of a hesitating legislature for funds to carry on the enterprise. With characteristic energy he organized a new plan of instruction, planned and superintended the erection of the college buildings, secured endowments, and, besides taking the general guidance of the institution, he gave instruction and superintended the practical investigations of the students in chemistry, scientific agriculture, mineralogy, and geology.

He had just succeeded in establishing a thoroughly scientific institution upon a broad and enduring basis, and in convincing a sceptical public of the ultimate success of such a noble enterprise, when death cut short his work. He died in Bellefonte, Pa., on the 29th of

April, 1864, after less than a week's illness, at the age of thirty-six.

C. M. WETHERILL, M.D.—Prof. Wetherill's researches, like his lamented and sudden death, are fresh in our memories. His early papers in 1848, in the *Annalen der Chem. und Pharm.*, were "On the Neutral Sulphates of Ethyloxyd, their Decomposition Products with Water" ("Ueber Neutrales Schwefelsaures Æthyloxyd und dessen Zersetzung Strodercte mit Wasser"), and "Analysis of the Subsulphate of Cinchona." The first of these papers is reproduced in the *Proc. Am. Phil. Soc.*, 1848. His last papers are "Experiments with the Ammonium Amalgam" (*Sill. Journ.*, 2, xl. pp. 160–165, 1865), and "On the Existence of the (so-called) Ammonium Amalgams" (*Sill. Journ.*, 3, i. pp. 369, 371, 1871), both of which are most creditable contributions. The first demonstrates that the ammonium amalgam, so called, is a metallic froth; the second that the compound ammonias, *e. g.*, methyl-ammonium-oxalate, may form the so-called amalgam. Dr. Wetherill published a number of other papers, chiefly analyses, *e. g.*, "Concretion from the Stomach of a Horse;" "Molybdate of Lead;" "Food of the Queen Bee;" "Mexican Honey Ant," etc.; "A New Apparatus for the Determination of Carbonic Acid" (May, 1873, *Journ. Frank. Inst.*, xxx. 333). "Examination of Fusel Oil from Indian Corn" (May, 1873, *Journ. Frank. Inst.*, xxx. 385). This is a valuable contribution, with a fractional distillation of the crude oil, an ultimate analysis of the silver salt of one of the fatty acids from the distillate ($C_{16}H_{15}O_4Ag$), and an examination of the alcohol of fusel oil. "Examination of Gas of the Philadelphia Gas Works" (1854, *Journ. Frank. Inst.*, xxviii. 35). "An apparatus for Organic Analysis by Illuminating Gas, and on the use of this Gas in Experimental Analysis" (1854, *Journ. Frank. Inst.*, xxviii. 107–115; 184–191; 274–279). "Description of an Apparatus for Broiling by Gas" (1854, *Journ. Frank. Inst.*, 121). His paper on "Adipocire and its Formation" (*Trans. Am. Philo. Soc.*, xi. 1855) contains the results of both chemical and microscopical examinations of adipocire, with an account of experiments on the decomposition of muscular fibre by water with a view to the formation of adipocire. In 1859 he published "Analysis of the White Sulphur Water of the Artesian well of Lafayette, Indiana" (*Sill. Journ.*, 2, xxvii. pp. 241–249); a carefully conducted investigation of permanent value. "On the Crystallization of Sulphur, and upon the Reaction between Sulphid of Hydrogen, Ammonia, and Alcohol" (*Sill. Journ.*, 2, xl. pp. 338–344); a research undertaken to determine the conditions requisite to produce octohedral and prismatic sulphur. "On the Crystalline Nature of Glass" (*Sill. Journ.*, 2, xli. pp. 16–27). This curious research has demonstrated the fallacy of the common opinion that glass is quite amorphous, and demands further investigation.

"Experiments on Itacolumite (Articulite), with the Explanation of its Flexibility and its Relation to the Formation of the Diamond" (*Sill. Jour.*, 2, xliv. pp. 61–71). This is a most ingenious and suggestive paper, and is an excellent illustration of the skill and ingenuity which the author brought to bear on a seemingly unpromising subject, whether we accept his conclusions or not.

The only volume published by Dr. Wetherill was his technical treatise, called "The Manufacture of Vinegar; its Theory and Practice, with Special Reference to the Quick Process," 1860, pp. 300, which is a very useful book.

There are other names of early laborers in the common field which are not forgotten, but time fails us that we should enumerate all in a summary which does not claim to be complete. The names of Renwick, Chilton, Dewey, T. Dwight Eaton, Elisha Mitchell; Thos. D. Mitchell, Steel, E. Hitchcock, Webster, Hall, Godon, S. G. Morton, Keating, W. R. Johnson, and others, are among the unrecorded ones in our Address.

No definite line of division can be drawn between the two moieties of our century of chemistry. The notice we have taken of those whose names have already been mentioned has, almost unavoidably, been somewhat biographical. For those who are yet in active work this course is, for obvious reasons, undesirable, and our notice of the contributions of living men must generally be much less personal. Before resuming our enumeration of contemporaneous work, it will be proper to touch briefly on some general considerations which naturally suggest themselves in this connection.

It is easy to see, by a review of the ground gone over, that, in the early history of chemistry in the United States, there were a few workers whose labors have made a sensible impression on the history of the science. Such were Rumford, Priestley, Hare, Silliman, Gorham, J. F. Dana, Wells, Bache, Seybert, Bruce, Torrey, Mather, Troost, Bowen, and others. As a department of academic training chemistry was generally provided for in most of the colleges, but it was usually coupled with natural philosophy and natural history, and was never made the subject of personal laboratory training other than by didactic and demonstrative lectures. Practical and analytical laboratories of instruction were unknown. With a few honorable exceptions, the incumbents of professorial chairs made no contributions to the advancement of science, or the stock of human knowledge. Text-books and manuals were supplied, prior to the appearance of those of Gorham and J. F. Dana, by the republication of European manuals, such as those of Henry, Murray, Brande, Chaptal, and the like. The subjects which very naturally occupied the attention of chemists here, as elsewhere, in the early part of this century were largely physical, growing naturally out of the excitement following the discovery of the pile of Volta, and its use by Davy in evolving potassium, sodium, and the other like metals from their combinations.

The "New Chemical Philosophy" of the French school had gradually won its way to complete supremacy over the phlogistic theory, although, as we have seen, Dr. Priestley to the last did battle valiantly for the doctrines of Stahl. But, although Davy's determination of the real nature of chlorine was the *coup de grace* to the old ideas, we still find the literature of chemistry full of desperate struggles to resist the dualistic philosophy which for more than half a century since has, until within the past twenty years, held almost undisputed dominion.

A few American chemists very early sought the advantages offered to students by the School of Mines in Paris—for example, the two Seyberts, Keating, Vanuxem, Clemson, etc., or, like Silliman and Gorham, found guidance in London and Edinburgh. But the advantages thus obtained were neither easy of access, nor otherwise well suited to the wants of students. Private laboratories of eminent chemists were at that time nearly closed to the access of students, few of whom enjoyed such advantages as the brothers Rose found in the laboratory of Berzelius. No chemical schools or laboratories were then organized for chemical training of stu-

dents in the arts of analysis, and the methods of research were unknown, in fact, until Liebig, in 1826, first threw open wide the doors of access to the laboratory at Geissen, and welcomed cordially all students without distinction of nationality to his scientific hospitality. It was there that Hoffmann, Will, and Fresenius were his assistants, and we find the names of Johnston, Lyon Playfair, and Gregory among his English-speaking students before the tide of American followers had set in. This marks an era in the scientific history of the world that made itself felt far and wide, and nowhere more than in the United States, although nearly twenty years later, when it contributed its quota to the events next to be considered.

Great Scientific Awakening about 1845.—The year 1845 marks the beginning of a new era in the scientific life of America, which is still in active progress, and chemistry has had its full share in this advance. Many circumstances conspired to bring about this increased activity, some of which we will briefly enumerate:—

Louis Agassiz arrived in the United States in the autumn of 1846, and commenced his wonderful course of scientific labor which has made itself felt in all departments of research, and has infused a zeal for scientific studies and research in the public mind before unknown. Coming only as a guest, and for a special mission, he found here a home which with joy opened to receive and adopt him as an American citizen, and has made his name a household word in every hamlet of this broad land.

The Smithsonian Institution, founded by an Englishman, was organized at Washington in 1846, and commenced its labors under the guidance of Prof. Joseph Henry in 1847. Opening wider and yet more freely the various paths of scientific research with every passing year, and placing the science-workers of America in intimate fellowship with their co-workers in all parts of the civilized globe, its influence for good is steadily increasing.

The United States Coast Survey had in 1845 just passed under the comprehensive direction of Prof. Alexander Dallas Bache, and was at the commencement of this new epoch in American science already making its power felt in all departments of research: co-ordinating, systematizing, and directing not only its own special methods, but extending its hospitality and encouragement alike to physicists, chemists, naturalists, and explorers—what a power it has ever been in this country for the advancement of science, and what a school for special training, is the cheerful acknowledgment of all who have any knowledge of scientific progress in the United States during the past thirty years.

Astronomical Observatories.—In 1845 Professor Ormsby Macknight Mitchel effected the establishing of the Astronomical Observatory at Cincinnati, since so renowned in astronomical history. Observatories had existed before in the United States at Yale (1830), Williams (1836), Western Reserve (1838), etc., but they were more or less imperfectly organized, and we believe that the efforts of General Mitchel at Cincinnati may be fairly looked upon as the starting point of that great activity in astronomy in this country, which has since developed itself, and has so unexpectedly, by aid of the spectroscope, connected astronomy and chemistry so intimately as to render them in some sense co-ordinated sciences.

The American Association for the Advancement of Science commenced its enlarged existence in 1848, being evolved out of the Association of American Geologists and Naturalists, which body at its last meeting in Boston, in 1847, resolved to enlarge its sphere of action, to include physics, chemistry, astronomy, and the allied physical sciences. This latter organization has itself been an outgrowth from an earlier organization, the American Association of Geologists, founded originally by the joint action of those who, in 1840, were charged with the conduct of the geological surveys of the States then prosecuting such explorations. The *Proceedings* of the American Association for the Advancement of Science at once opened a new channel of communication for the workers in science, while the migrations of the association tended doubtless to quicken the public interest in scientific pursuits.

The American Philosophical Society had a little earlier, in 1843, held its centennial celebration in Philadelphia, an event which stimulated to renewed activity the oldest of American scientific societies, and drew together a large number of co-workers from distant places to participate in this scientific festival. It was fit that the oldest scientific organization in this country, with a noble record of work in the first quarter of our chemical century, should join with fresh vigor in the great awakening which has distinguished the latter quarter of the same century.

The American Journal of Science closed its first half century of volumes in 1845, and commenced its second series in the year 1846 under an enlarged editorial management, and with more frequent issues, thus offering to investigators more frequent contact with their fellow-workers.

The year 1847 witnessed also the inauguration of the system of schools for science training in some of the older colleges, which has since led the way to the establishing of like schools far and wide.

At Yale College in 1847 was instituted the "Department of Philosophy and the Arts," and work was commenced under it in the "Yale Analytical Laboratory" under the instruction of Professors Norton and Silliman, Jr. This effort was almost without any endowments in money, and was carried on for some years exclusively at the personal charge of the two professors, who not only paid their own salary, but furnished the laboratories, library, apparatus, and collections, and even paid a rent to the academical department for the use of the old presidential house, which they had also paid for fitting up for the use of the school. From the very commencement of this work by Professor Silliman, Jr., some four or five years before, in a small way, evidence was not wanting in the gathering of pupils of the existing necessity for such instruction.

At Harvard in the same year Mr. Abbott Lawrence had just made an endowment of fifty thousand dollars, at that time of unparalleled munificence, which became at once the starting point of the "Lawrence Scientific School" under the direction of Professor E. N. Horsford, who had then but recently returned from the instructions of Liebig. How suggestive, and fruitful in noble emulation, this good example of Lawrence has been in the scientific endowments of seats of learning, we may see on every hand. It is only necessary to mention the names of Sheffield, of Peabody, of Williston, of Hopkins, of Chandler, of Judd, of Packer, of Pardee, of Edwin A. Stevens; the endowments of Agassiz's Museum of Comparative Zoology of the Harvard Observatory, of the Winchester Observatory at Yale, and, lastly, of the more than regal munificence to science by the gifts of James Lick upon the Pacific coast, and of others

which might properly be mentioned—to see at once the cause and effect of our increased activity in all departments of scientific research.

But this is not all.

The conquest of Mexico by the United States in 1845, the acquisition of California, and the subsequent discovery of its gold and of the gold of Australia, are events which have most obviously added their powerful stimulus to the general activity of the entire country, and, we may add, of the world, awakening the public mind to the importance of physical studies, and aiding to give them a rank in the general estimate they had never before attained, whether as means of intellectual and general culture, or as ends for the attainment of wealth and power. Without the almost convulsive shock thus imparted to the old-time system of education, by the union and focalization of all these and other like causes, the inertia with which the arguments for a more comprehensive training in our institutions of learning were so long successfully resisted, would still continue, and the "humanities" of mediæval scholasticism would have never relaxed their almost exclusive dominion in a polite education. That we are here to-day as chemists. and to celebrate this new Atlantis "for the glory of the Creator and the relief of man's estate," is in testimony that a great advance has been made upon the old traditions—a victory achieved, and with a yet more fruitful future before us and those who are to follow.

Thus on every hand, under the inspiration of these combined influences, and others of a like nature not so conspicuous, was the educated mind of America directed with new intent toward all departments of scientific study, and a revival of learning followed, which happily is still in full progress. The work in the various geological and other explorations already undertaken. or, like the Wilkes expedition, just completed, had, in 1845, furnished a small band of picked men trained for original research. Chemical students, drawn to Europe by the attraction of the writings of Liebig and the laboratory training of Wöhler and others were returning to infuse new activity and accuracy into chemical studies, establishing laboratories for research in various departments of original investigation.

There had, indeed, been a partial kindling of a like nature twenty-five or thirty years before, when the early munificence of William Maclure aroused in Philadelphia and New Haven, and to some extent in other cities, a remarkable zeal for the study of geology, mineralogy, and general natural history, followed by the publication of his geological map of the United States, by the establishing of the "Academy of Natural Sciences" in Philadelphia, the "Lyceum of Natural History" in New York, and the "American Geological Society" in New Haven. But the failure of Mr. Owens's educational scheme at New Harmony, where Mr. Maclure had made a heavy investment. and had carried an important part of his collection of books and natural history specimens, accompanied by Say, Leseur, and others, ending in his removal to Mexico, where his delicate health compelled him to reside, led the way to a considerable suspension of this new activity in science. Nearly all the publishing societies in America became dormant, or languished with intervals of spasmodic activity. Some of them died entirely. *Bruce's Journal* died, and a period of general stagnation in scientific activity prevailed for some years. This gradually yielded to better influences. Chemistry was making slow but steady progress. Evidence of original work began to appear in this and the cognate sciences, as will be seen by what has already been recorded, and thus the way was opened for the entrance of those combined influences which developed themselves, as we have just specified, about the years 1845–47, under circumstances so auspicious.

[In the following enumeration of clinical contributions by authors now living, an effort has been made, as far as practicable, to preserve a chronological order; but this could not be very strictly observed. It was at first intended to classify the contributions to chemistry in this country subjectively; but this was found to be inconsistent with the effort to do each worker the fairest amount of justice possible. Nor has it been thought essential to preserve a strict order in the mode of enumerating papers. The author has desired to make this list as complete as possible, but he is sensible of its imperfections, while he is at the same time unconscious of any intentional omissions, and hopes for a friendly indulgence where omissions exist. To those who have kindly responded to his request for assistance in preparing the lists which follow, he returns his thanks, and he takes this occasion to remind others if they find their lists incomplete, that they have had an opportunity to make them otherwise.]

JOSEPH HENRY, Washington, D. C.—Professor Henry, now the Nestor of American science, has devoted his great powers, during a long and active life, chiefly to other branches of science and administrative duty, and with what eminent success need not be recounted here. But we find him early in his scientific studies at work in the laboratory of Dr. T. R. Beck, in Albany, and afterwards, in the absence of Dr. John Torrey, delivering the chemical lectures at Nassau Hall, in Princeton. While in Albany with Dr. Beck, he devised and published an improved form of Wollaston's sliding scale of chemical equivalents, in which hydrogen was adopted as the radix, a contrivance which is hardly known, even by name, to the present generation of chemists.

Prof. Henry, in the discharge of his duties as the Secretary of the Smithsonian Institution, has had it in his power greatly to advance chemical science, both by encouraging original researches in the laboratory of the institution and elsewhere, and also in his Annual Reports and in the Smithsonian Contributions and Miscellaneous Collections, by publishing chemical memoirs by American chemists, and promulgating a knowledge of those undertaken, either by encouragement of the Smithsonian, or elsewhere.

By his own original researches in electro-magnetism, commenced in Albany in 1826, and continued at Princeton after his removal to Nassau Hall, Prof. Henry has contributed more than any other American to the advancement of that important department of physics, which has been so fruitful in the hands of inventors in new and important practical applications closely affiliated to chemistry.

Prof. Henry's original contributions to science have been chiefly physical, but they fall largely into the department of chemical physics.

The following is a brief enumeration of his scientific investigations and discoveries:—

1. A sketch of the topography of the State of New York, embodying the results of the survey before mentioned.

2. In connection with Dr. Beck and the Hon. Simeon De Witt. the organization of the meteorological system of the State of New York.

3. The development, for the first time, of magnetic power, sufficient to sustain tons in weight, in soft iron, by a comparatively feeble galvanic current.

4. The first application of electro-magnetism as a power, to produce continued motion in a machine.

5. An exposition of the method by which electro-magnetism might be employed in transmitting power to a distance, and the demonstration of the practicability of an electro-magnetic telegraph, which, without these discoveries, was impossible.

6. The discovery of the induction of an electrical current in a long wire upon itself, or the means of increasing the intensity of a current by the use of a spiral conductor.

7. The method of inducing a current of quantity from one of intensity, and *vice versa*.

8. The discovery of currents of induction of different orders, and of the neutralization of the induction by the interposition of plates of metal.

9. The discovery that the discharge of a Leyden jar consists of a series of oscillations backwards and forwards until equilibrium is restored.

10. The induction of a current of electricity from lightning at a great distance, and proof that the discharge from a thunder cloud also consists of a series of oscillations.

11. The oscillating condition of a lightning-rod while transmitting a discharge of electricity from the clouds, causing it, though in perfect connection with the earth, to emit sparks of sufficient intensity to ignite combustible substances.

12. Investigations on molecular attraction, as exhibited in liquids, and in yielding and rigid solids, and an exposition of the theory of soap bubbles. [These originated from his being called upon to investigate the causes of the bursting of the great gun on the United States Steamer Princeton.]

13. Original experiments on and exposition of the principles of acoustics, as applied to churches and other public buildings.

14. Experiments on various instruments to be used as fog signals.

15. A series of experiments on various illuminating materials for light-house use, and the introduction of lard oil for lighting the coasts of the United States. This and the preceding in his office of Chairman of the Committee on Experiments of the Light-House Board.

16. Experiments on heat, in which the radiation from clouds and animals in distant fields was indicated by the thermo-electrical apparatus applied to a reflecting telescope.

17. Observations on the comparative temperature of the sun-spots, and also of different portions of the sun's disk. In these experiments he was assisted by Professor Alexander.

18. Proof that the radiant heat from a feebly luminous flame is also feeble, and that the increase of radiant light, by the introduction of a solid substance into the flame of the compound blowpipe, is accompanied with an equivalent radiation of heat, and also that the increase of light and radiant heat in a flame of hydrogen, by the introduction of a solid substance, is attended with a diminution in the heating power of the flame itself.

19. The reflection of heat from concave mirrors of ice, and its application to the source of the heat derived from the moon.

20. Observations, in connection with Professor Alexander, on the red flames on the border of the sun, as observed in the annular eclipse of 1838.

21. Experiments on the phosphorogenic ray of the sun, from which it is shown that this emanation is polarizable and refrangible, according to the same laws which govern light.

22. On the penetration of the more fusible metals into those less readily melted, while in a solid state.

Besides these experimental additions to physical science, Professor Henry is the author of twenty-five [1846–71] reports, giving an exposition of the annual operations of the Smithsonian Institution. He has also published a series of essays on meteorology in the Patent Office Reports, which, besides an exposition of established principles, contain many new suggestions; and, among others, the origin of the development of electricity, as exhibited in the thunder-storm; and an essay on the principal source of the power which does the work of developing the plant in the bud, and the animal in the egg.

He has also published a theory of elementary education, in his address as President of the American Association for the Advancement of Education, the principle of which is, that in instruction the order of nature should be followed; that we should begin with the concrete and end with the abstract, the one gradually shading into the other; also the importance of early impressions, and the tendency in old age to relapse into the vices of early youth. Youth is the father of old age rather than of manhood.

He was successful as a teacher, and never failed to impart to his students a portion of his own enthusiasm. His object was not merely to impart a knowledge of facts, but mainly to give clear expositions of principles; to teach the use of generalizations, the method of arriving at laws by the process of induction, and the inference from these of facts by logical deduction.

Henry Seybert, of Philadelphia, like his father, Adam Seybert, was educated in the School of Mines in Paris, and was an early contributor to our knowledge of the chemical constitution of American minerals. In 1822 he analyzed the sulphuret of molybdenum from Chester, Pa.; chromate of iron from Maryland and Pennsylvania; the tabular spar, pyroxene, and colophonite of Willsborough, N. Y., and the maclureite (chondrodite) of New Jersey (in which he independently discovered fluorine as Dr. Langstaff had done before). He also analyzed the manganesian garnet found with the chrysoberyl at Haddam, Conn., and the chrysoberyl of the same locality. In 1830 he analyzed the Tennessee meteorite of Bowen, since which date I have been unable to find any further contributions from Mr. Seybert, whose attention was unfortunately diverted from science, to which his early life was so advantageously devoted, to other and less fruitful lines of investigation.

Charles Upham Shepard, M.D., New Haven.—From the year 1824 to this time Prof. Shepard's name has been intimately associated with the progress of American mineralogy and the study of aerolites. His chemical work has been largely given to the examination of meteoric masses, to which he has devoted special attention, amassing probably the finest collection of these remarkable bodies which exists in America. Nearly all his papers on mineralogy and meteorites have appeared in the *American Journal of Science* and in the Proceedings of the American Association for the Advancement of Science, and for a full list of titles reference may be had to these works. The catalogue of the Royal Society contains, prior to 1863, titles of seventy-eight papers by Prof. Shepard. In 1832 he

published his "Treatise on Mineralogy," based on the natural system of Mohs, and subsequent editions have appeared in 1844, 1852, and 1857.

No observation or original research of Dr. Shepard has been fruitful of so much good in its consequences as his discovery, about 25 years ago, of the deposit of phosphate of lime in the Eocene marl of South Carolina, and the distinct recognition of the fact of its great value for agriculture. This discovery led, in 1859–60, to finding, in the immediate vicinity of Charleston, the richest phosphates directly above and upon the Eocene, and to its introduction into commerce on a vast scale, and the manufacture of superphosphate fertilizers, not alone for this country, but for foreign export, and the growth in consequence of an important industry in the chemical arts at Charleston.

Augustus A. Hayes, Brookline, near Boston, Mass.—Dr. Hayes has been an industrious worker in chemistry from an early date until the failure of his health some ten years since. His papers are scattered over a wide range, and the following is only a partial list:—

1831. Production of Hydrocyanic Acid under unusual circumstances. *Journ. Royal Inst.*, i. 169.

1848. Native Copper from Lake Superior. *Am. Acad. Proc.*, ii. 195.

1848. On the Urinary Deposit called Red Sand. *Ibid.*, 196.

1848. On Stereopene, or Camphor from Crude Oil of Valerian. *Ibid.*, iii. 99–100.

1850. On the Assumed Existence of Ammonia in the General Atmosphere. *Proc. Am. Ass.*, iv. 207–213.

1852. On a New Species of Wax. *Am. Acad. Proc.*, iii. 190.

1852. On Native Iron from Siberia. *Ibid.*, iii. 149.

1852. On Aluminium. *Ibid.*

1852. Bessemer Process; New Points of Chemical Interest. *Ibid.*, iii. 322.

1852. Fossilized Egg from the Guano Island. *Proc. Boston Nat. Hist. Soc.*, v. 165.

1852. On Cochituate Water. *Ibid.*, 169.

1852. Analysis of a Saline Mineral from South America. *Ibid.*, v. 192–390.

1852. On the State in which Phosphate of Lime Exists in Sea-Water. *Ibid.*, vi. 48.

1852. Analysis of a Specimen of Gum from Africa. *Ibid.*, vi. 129.

1852. On a kind of Sugar developed in Sorghum. *Ibid.*, 200–203. 207–209.

1852. On some Modified Results attending the Decomposition of Bituminous Coals by Heat. *Ibid.*, vii. 50–51; also, in *Am. Journ. Sci.*

1857. On the Composition of the so-called Guano of the Atlantic Islands. *Edinb. N. Phil. Journ.*, ii. 107.

1857. Corrosion of Yellow Metal. *Am. Acad. Proc.*, iv. 28.

1857. Chemical Examination of a Substance found in the Medullary Cavity of Trees in the Sandwich Islands. *Proc. Boston Soc. Nat. Hist.*, vii. 209.

1861. On the Occurrence of Soluble Compounds of Copper, Lead, and Zinc in Alcohol. *Lond. Chem. News*, iv. 117.

1870. On the Cause of the Color of the Water of Lake Leman, Geneva. *Am. Journ. Sci.* [2], xlx. 186.

1872. On the Red Oxide of Zinc of New Jersey. *Ibid.* [3], iv. 191.

Lewis Feuchtwanger, M.D., New York.—Dr. Feuchtwanger has been known to American chemists by his commercial establishment for the manufacture and sale of rare chemicals for over forty years. He has also added something to our literature.

1831. Remarks on Arsenic, with Drawings of the Color of its Precipitates formed by Reagents applied to them. *Sill. Journ.*, xix. 339, with a colored plate.

1837. Expeditious Mode of Manufacturing Vinegar. *Ib.*, xxxi. 272.

1867. A Popular Treatise on Gems, 12mo. pp. 505, and a new edition in 1872.

1872. Remarks on Glass Making. *Proc. Am. Ass.*, xxii. 88.

Robert Peter, M.D., Professor of Chemistry in the University of Transylvania, Lexington, Ky.—Dr. Peter, who is one of the oldest chemists in the United States, has been connected with the geological surveys of Kentucky and Indiana, as well as with various institutions of learning. His published papers are in part as follows:—

1834. Thoughts on the Application of Chemistry to Medicine. *Transyl. Med. Journ.*, vol. vii.

1834. An Account of the Vegetable Alkalies, including their Therapeutic Action when applied internally or by the Endermic Method. *Ibid.*

1835. Notice of the Crab Orchard Mineral Springs (Lincoln County, Ky.), with a Chemical Analysis of Four of the Waters. *Ibid.*, vol. viii.

1846. Chemical Analysis of Urinary Calculi in the Museum of the Medical Department of Transylvania University, with Remarks on the Relative Frequency of Calculi in Lexington, Ky., and the Probable Causes. *Western Lancet*, vol. v.

This paper was subsequently reproduced with thirty-four additional pages, and several new analyses in the *Transylvania Med. Journ.*, N. S.

1849. Remarks on the Agriculture of the Blue Limestone of Kentucky, with its Analysis. *Albany Cultivator*, Albany, N. Y., vol. v.

1849. On Ozone. On Magnesia as an Antidote to Arsenic. } In the *Trans. Med. Journ.*, vol. i., N. S.

1850. The Quantitative Analysis of the Water of the Lower Blue Lick Spring, in Nicholas Co., Ky., with remarks on some other Salt Springs of the Blue Limestone Formation. *Quar. Med. Journ.*, Lexington.

1852. A series of lectures (contributed to same Journal) on the Chemical Relations of Organic Bodies, and on the Chemistry of the Urine.

1856. Chemical Analysis of Soils, Minerals, Rocks, Ores, Coals, Waters, etc. etc., with remarks covering 124 pages of vol. i. of the Reports on the Kentucky Geological Survey. 8vo.

1857. To vol. ii. of same Report, 184 pages containing the account of 206 chemical analyses contributed to the work by Dr. Peter.

1857. To vol. iii. of same report, Dr. Peter contributed 247 pages, and 220 chemical analyses with remarks.

1861. To vol. iv. of same report, he contributed 291 pages, with 529 chemical analyses, etc.

1860. In the Second Report of a Geological Reconnoissance of the Southern and Middle Counties of Arkansas, made during the years 1859–60, by Dr. David Dale Owen, Geologist (Phila., 8vo. pp. 433), etc., Dr. Peter, as the chemist to the survey, contributed an account of 271 chemical analyses by himself of the soils, subsoils, under-clays, nitre-earths, etc., of Arkansas, with remarks covering 125 pages.

1860. In Report of a Geological Reconnoissance of Indiana by Dr. D. D. Owen, made during 1859–60, Dr. Peter contributed the chemical analyses of thirty-three soils, subsoils, etc. Indianapolis, 1862, pp. 368, 8vo.

1873. Dr. Peter adds to his former chemical work on the Geological Survey of Kentucky (Prof. N. S. Shaler Chief Geologist), a new chapter in the report now about to be published.

JOHN WILLIAM DRAPER, Prof. of Chemistry New York University, New York.—Few men of science now living in America have been so long and so favorably known in the various departments of scientific investigation, which he has followed, as Dr. Draper. His reputation is cosmopolitan, and many of his publications have been reproduced in several European languages. The following is believed to be a full list of Dr. Draper's scientific papers, arranged in chronological order. Many of them are not, properly speaking, chemical, but belong rather to the department of molecular physics.

1834. "On Capillary Attraction," showing that it is an electrical phenomenon, and containing an explanation of endosmosis, *Journ. Frank. Inst.*, Sept., 147.

1834. "Analysis of Native Chloride of Carbon," *Journ. Frank. Inst.*, Nov., 295.

1834. "On a Galvanic Battery of Four Elements," *Journ. Frank. Inst.*, Nov., 289. It contains the voltaic decomposition of fused salts, and reducing effect of liberated hydrogen.

1835. "Experiments to determine whether Light has any Magnetic Action," *Journ. Frank. Inst.*, Feb.

1836. "Experiments on the Tidal Motions of Conductors Free to Move," being an investigation of the figure of equilibrium, and the motions of masses of mercury under the influence of a voltaic current, *Frank. Inst. Journ.*, January.

1836. "Analysis of some Ancient Coins," *Silliman's Amer. Journ.*, vol. xxix., 157.

1836. "Experiments on Endosmosis," *Frank. Inst. Journ.*, March.

1836. "Endosmosis through Water Strata and Soap Bubbles," *Frank. Inst. Journ.*, July.

1836. "On Interstitial Movements," *Amer. Journ. Med. Sci.*, May.

1836. "Observations on Microscopic Chemistry," *Journ. Frank. Inst.*, Dec.

1837. "Experiments on Solar Light," *Frank. Inst. Journ.*, June, July, Aug., Oct. These contain, among many other things, experiments on the absorption of the chemical rays, decomposition of carbonic acid by light, diffraction of the chemical rays, deposition of camphor crystals, and effects of light on vegetation.

1838. "On the Physical Theory of Capillary Attraction," *Amer. Journ. Med. Sci.*, Feb.

1838. "On the Great Mechanical Force Generated by the Condensing Action of Tissues." showing that gases will diffuse into each other against the pressure of many atmospheres and the voltaic decomposition of water under heavy pressures, *Amer. Journ. Med. Sci.*, May.

1838. "On the Physical Theory of Endosmosis," *Amer. Journ. Med. Sci.*, Aug.

1838. "On the Constitution of the Atmosphere," *Lond. Phil. Mag.*, Oct.

1839. "On the Measurement of the Tension of Electrical Currents," *Phil. Mag.*, Oct., Nov.

1840. "Some Experiments on the Sun's Light, made in the South of Virginia," *Phil. Mag.*, Feb.

1840. "On the Electromotive Power of Heat," containing a description of improved thermo-electrical couples, *Phil. Mag.*, June.

1840. "On the Taking of Portraits from the Life by the Daguerreotype," *Phil. Mag.*, Sept. This memoir contains the first description published on photographic portraiture.

1841. "On some Analogies between the Chemical Rays and Radiant Heat," *Phil. Mag.*, Sept.

1842. "On a New Imponderable Principle," *Phil. Mag.*, Dec.

1843. "On Certain Spectral Appearances connected with Photography, and on Latent Light,' *Silliman's Journal*, vol. xliv.

1843. "On the Law of the Conducting Power of Wires for Electrical Currents," an investigation connected with Morse's invention of the telegraph, *Silliman's Journal*, vol. xlv.

1843. "Photographic Copies of the Fixed Lines of the Spectrum." This memoir contains the description of many new lines, both in the ultra red and ultra violet spaces. *Phil. Mag.*, May.

1843. "On the Decomposition of Carbonic Acid by Plants in the Prismatic Spectrum." Up to this time it was supposed that the deoxidation of carbonic acid is accomplished by the violet rays; this memoir showed that it is by the yellow rays. *Silliman's Journal*, vol. xlvi., *Phil. Mag.*, Sept.

1843. "On a Change Impressed by Light in the Properties of an Elementary Substance," *Phil. Mag.*, Nov.

1843. "Description of the Chlorine and Hydrogen Photometer (Tithonometer)," an instrument subsequently used extensively by Bunsen and Roscoe in their photo-chemical researches. *Silliman's Journal*, vol. xlvi., *Phil. Mag.*, Dec.

1844. "On Tithonized Chlorine," *Phil. Mag.*, July.

1844. "On a Fourth Imponderable," *Phil. Mag.*, Aug.

1845. "On Capillary Attraction," *Phil. Mag.*, March.

1845. "On the Interference or Diffraction Spectrum," *Phil. Mag.*, June.

1845. "On the Allotropism of Chlorine as Connected with the Theory of Substitutions," *Silliman's Journal*, vol. xlix.

1845. "On the Light of Ignited Lime and the Electric Spark," *Phil. Mag.*, Dec.

1846. "On the Circulation of the Blood as depending on Chemical Action," *Silliman's Journal*, 2d series, vol. ii.

1847. "On the Negative or Protecting Rays of the Spectrum," *Phil. Mag.*, Feb.

1847. "On the Production of Light by Heat." This memoir contained many facts published subsequently (1860) without due acknowledgment by M. Kirchoff in his celebrated memoir as mathematical deductions. *Silliman's Journal*, 2d series, vol. iv., *Phil. Mag.*, May.

1848. "On the Production of Light by Chemical Action," *Silliman's Journal*, 2d series, vol. v., *Phil. Mag.*, Feb.

1849. "On the Allotropism of Living Beings," *Phil. Mag.*, April.

1851. "On Phosphorescence," *Phil. Mag.*, Feb.

1851. "On the Chemical Action of Light," *Phil. Mag.*, May.

1853. "On a New Method for the Quantitative Estimation of Urea," *Phil. Mag.*, Oct.

1857. "On the Diffraction Spectrum," *Phil. Mag.*, March.

1857. "On Photometry," *Phil. Mag.*, Sept.

1857. "On the Modification of Chlorine," *Phil. Mag.*, Nov.

1858. "On the Nature of Flame and Condition of

the Sun's Surface," *Silliman's Journal*, 2d series, vol. xxvi., *Phil. Mag.*, Feb.

1872. "On the Distribution of Heat in the Spectrum," *Silliman's Journal*, 3d series, vol. civ., 161.

1873. "On the Distribution of Chemical Force in Spectrum," *Silliman's Journal*, 3d series, vol. cv., 25.91.

Besides these he published in 1844 a volume entitled "A Treatise on the Forces which Produce the Organization of Plants." In this were collected many of his memoirs on photo-chemical and other subjects, and among them:—

"On the Influence of Physical Agents on Organization and Life."

"On the Action of the Sunbeams in Producing Organized Bodies."

"On the Mechanical Cause of the Flow of Sap in Plants—it is due to the Carbonization of Water on the Leaves by the Light of the Sun."

"On the Physical Constitution of the Sunbeam, and on the Prismatic Spectrum."

"On the Diffraction Spectrum" (with a colored plate).

"Experiments proving that it is in the Yellow Region of the Spectrum that Reduction of Carbonic Acid by the Leaves of Plants takes place."

"On the Theory of Ideal or Imaginary Coloration."

Many of the above memoirs have been translated into French, German, Italian, and republished in various European journals.

In 1856 Dr. Draper published a Treatise on Human Physiology, containing, in like manner, the solution of many chemico-physiological and physical questions respecting digestion, absorption, the flow of the chyle and lymph in their special vessels, the mechanical action of the heart, the dependence of circulation on respiration, the nature of nervous action, the functions of the different portions of the ear, the tympanum, cochlea, semicircular canals; the nature of vision, and explanation of the functions of different portions of the eye; the influence of physical agents on the organic series. This work has been translated into Russian, and is largely used in the schools of that country.

It may be added that Dr. Draper took the first photographic portrait of the human face, and thereby laid the foundation of what has since become an important branch of industry; the first photograph of the moon; the first photograph of the diffraction spectrum. Simultaneously with Becquerel, he photographed the Fraunhofer fixed lines of the spectrum, and the ultra violet ones, and was the first to discover the great bands in the ultra red region.

In the midst of so much scientific activity, Dr. Draper has found time for relaxation in purely literary pursuits. He has published historical works on the Intellectual Development of Europe, and on the American Civil War, which have been translated into almost every European language; but these are sujects outside of the present memoir.

Rogers.—There have been five persons of this name in the United States who have been more or less intimately connected with the history of the science by their contributions and labors. They are all of one family, the father and four sons, whose names are familiar the world over. The father—

Dr. P. K. Rogers was the Professor of Natural Philosophy and Chemistry at the College of William and Mary in Virginia, from 1819 to 1829. If Dr. Rogers had made no other contribution to the progress of chemistry in the United States than to have trained four sons to the pursuits of science, he has left record which is probably without a parallel. But we know that he was an able and faithful teacher of the science, and his labors live in the lives of his pupils.

Wm. B. Rogers, so well known in many departments of scientific research in this country, succeeded his father in the same chair at William and Mary, where he remained until his transfer to the University of Virginia at Charlottesville, in 1836. His scientific labors have been largely geological and physical, but he has also conducted many chemical researches, both alone and in connection with his brothers Robert E. and Henry D. Rogers. We note the following researches by himself alone:—

"On the Existence of Bi-malate of Lime in the Berries of the Sumac (*Rhus glabrum* and *R. Copallinum*) and the Mode of Procuring it from them in the Crystalline Form." (*Am. Journ. Sci.*, xxvii., 1835, pp. 294–299.)

"Apparatus for Analyzing Marl and other Carbonates," and "Self-filling Syphon for Chemical Analysis." (*Am. Jour. Sci.*, xxvii. 299–303.)

"Analysis of (recent) Shells." (1834, *Am. Jour. Sci.*, xxvi. 361.)

"On the connection of Thermal Springs, in Virginia, with Anticlinal Axes and Faults." (1843, *Reports Am. Asso. Geol. and Nat.*, pp. 323–347.) In this important memoir Prof. Rogers gives in a tabular form the results of his Analysis of twenty-eight of the Virginia thermals, and points out particularly the preponderance of free nitrogen among the gaseous contents, much exceeding the CO_2 and H_2S in volume. This paper contains but a small part of the chemical work of the years when, as geologist of Virginia, Prof. Rogers was engaged in an examination of the thermal waters of that vast State. Unfortunately for science the arrest of that work has kept the full results of Prof. Rogers' labors from seeing the light.

"On Ozone Observations" (1858, *Edinb. N. Phil. Jour.*, vii. 35–42). The experiments detailed in the treatise confirm the observations of M. Cloez (*Ann. de Chem.*, 1857, l. pp. 80–96), showing that the effects supposed to be due to ozonized oxygen evolved from growing plants are really due to sunlight and moisture.

"An account of Apparatus and Processes for the Chemical and Photometrical Testing of Illuminating Gas." (*Brit. Asso. Report*, 1864, ii. p. 39.)

Many minor papers by Prof. R. will be found in the *Journ. of the Franklin Inst.*, *Proceed. Am. Phil. Soc.*, of the *Am. Acad.*, and *Am. Ass.*

W. B. Rogers and Robert E. Rogers.—These chemists have together published a number of important chemical contributions, relating chiefly to new or improved methods in chemical analysis and research. Such is their

"New Process for Obtaining Pure Chlorine." (*Sill. Jour.*, 2, i. 428, 1840.)

"On a New Process for obtaining Formic Acid, and on the Preparation of Aldehyd and Acetic Acid by the Use of Bichromate of Potassa." (*Sill. Jour.*, 2, ii. pp. 18–24.)

"On the Absorption of Carbonic Acid by Liquids." Part I. (*Sill. Journ.*, 2, vi. pp. 96–109.) Part II. is in *Proc. Am. Ass.*, 1850, pp. 298–311.

"Oxydation of the Diamond in the Liquid Way." (*Proc. Am. Asso.*, vi. 110.)

"On the Decomposition of Rocks by Meteoric

Waters." (*Proc. Am. Ass.*, 1848, p. 60; *Sill. Journ.*, 2, v. 401.)

"On the Volatility of Potassa and Soda and their Carbonates." (*Proc. Am. Ass.*, 1848, pp. 36–38.)

"On the Use of Hydrogen Gas and Carbonic Acid Gas, to Displace Sulphuretted Hydrogen in the Analysis of Mineral Water," etc. (*Sill. Jour.*, 2, xviii. 213–216, 1854.)

"On a New Method of Determining Carbon in Graphite." (*Sill. Journ.*, 2, v. 352.) This process turns out to be one of the best methods known of determining carbon in the analysis of cast-iron, and is now in constant use in many laboratories for this purpose.

"On the Oxydation of the Diamond in the Liquid Way." (*Sill. Journ.*, 2, vi. 110.) Chromic acid is the agent used.

"On New Instruments and Processes for the Analysis of the Carbonates." (*Sill. Journ.*, 1, xlvi. 346–359.)

Robert E. Rogers and M. H. Boyé.—"On the Analysis of Limestone, especially of the Magnesian kind, and a method of completely separating limes from Magnesia, where both are present in large quantity." (*Frank. Inst. Journ.*, 1840, xxv. pp. 158–162.)

Robert E. Rogers and James B. Rogers.—"On the Alleged Insolubility of Copper in Hydrochloric Acid, and on Fuch's Method of Analyzing Iron Ores." (*Sill. Journ.*, 2, vi. pp. 395 (abstract), and *Am. Asso. Proc.*, Philadelphia, 1848.

Henry D. Rogers wrote chiefly on geology, to which science his contributions are among the most important made in the United States. The joint memoir by himself and Wm. B. Rogers on the structure of the Appalachian, presented at the Boston Meeting of the American Association of Geologists and Naturalists in 1843 (*Trans.*, pp. 474–532), is too well known to require comment from us.

In connection with his brother, W. B. Rogers, Prof. H. D. Rogers in 1835 communicated an important chemico-physical paper entitled "Experimental Inquiry into some of the Laws of the Elementary Voltaic Battery." (*Sill. Journ.*, 1, xxvii. pp. 39–61.)

Some years before his death (in May, 1868) Prof. H. D. Rogers removed to Scotland, where, in 1857, he assumed the duties of the chair of geology and natural history. His enduring monument as a man of science is found in the "Report on the Geology of Pennsylvania." (3 vols. 4to. and atlas.)

It will never be forgotten that the Massachusetts Institute of Technology owes its conception and successful inauguration among the science-teaching institutions of America almost solely to the personal efforts of Prof. Wm. B. Rogers, who presided over its councils until compelled a few years since by failing health to resign its arduous duties.

John Johnston, Professor of Chemistry at Wesleyan University, Middletown, Connecticut, has published the following articles in the *American Journal of Science*:—

1836. [1] Vol. xxx. p. 387. Description of a large Crystal of Columbite.

1839. [1] Vol. xxxviii. 297. Description of Apparatus for preparing liquid and solid CO_2.

1838. [1] Vol. xxxiv. 86. Description of a peculiar Air-pump.

1841. [1] xl. 41. Description of Precious Beryl.

1864. [11] xxxvii. 115. Electric Properties of Pyroxilin Paper.

Prof. Johnston has also published :—

1840. Text-book of Chemistry; on the Basis of Dr. Turner's Elements of Chemistry. This has been revised three or four times in as many new editions.

Elements of Chemistry; an abridgment of the foregoing.

James C. Booth, Ph.D., Philadelphia.—Dr. Booth has contributed the following papers which we have found, and probably others of which I have no notice.

1836. On the Deutarseniuret of Nickel, from Riechelsdorf in Hessia. *Sill. Journ.* [1], xxix. 241.

1841. Analysis of Various Ores of Lead, Silver, Copper, Zinc, Iron, etc., from King's Mine, Davidson County, North Carolina. *Ibid.* [1], xli. 348.

1842. On Beet Root Sugar. *Journ. Frank. Inst.*, and Sturgeon, *Ann. Elect.*, v. 388.

1842. Chrome Iron Analysis. *Ibid.*

1848. Constitution of Glycerine and Oily Acids. *Journ. Frank. Inst.*, xx. 365.

1852. On Remingtonite, a New Cobalt Mineral. *Sill. Journ.* [2], xiv. 38.

In joint authorship with Martin H. Boyé.

1842. Analysis of Well Water in Philadelphia. *Journ. Frank. Inst.* [3], iii. 249.

1842. On the Extraction and Decolorization of Gelatine. *Ibid.*, May, 1842.

1842. On the Preparation of Aluminous Mordants. *Ibid.*

1843. Conversion of Benzoic Acid into Hippuric Acid. *Am. Phil. Soc. Proc.*, iii. 129.

1844. Analysis of Three Kinds of Feldspar. *Ibid.*, ii. 53.

In joint authorship with T. H. Garrett :—

1862. Experiments on Illumination with Mineral Oils. *Journ. Frank. Inst.*, xxv. 193.

In joint authorship with C. Morfitt.

1853. On the Analysis of Cast Iron. *Ibid.* [3], xxv. 193, 247, 317.

1862. Recent Improvements in the Chemical Arts. *Smithsonian Miscellaneous Collections.*

In joint editorship with Martin H. Boyé.

1844. The Encyclopedia of Chemistry. Phila., 8vo.

Report on the Geology of Delaware with Chemical Notes. 8vo.

Charles T. Jackson, Boston.—Dr. Jackson was one of the earliest chemists in the United States to open a laboratory (1838) for instruction and research in analytical chemistry in Boston, where several of the active men of our time obtained their first lessons in the art of chemical analysis. Most of Dr. Jackson's contributions to chemistry have been made in connection with the work of the Geological Surveys of which he had charge, as those of Rhode Island, Maine, New Hampshire, Lake Superior, etc. His memoir, in connection with Francis Alger, on the Geology and Mineralogy of Nova Scotia was an important contribution to science, and gave us our first exact knowledge of that interesting region. He has been recognized and decorated by many European governments as the discoverer of the anæsthetic powers of ether. His alcohol blast-lamp for alkaline fusions of silicates was a powerful heating apparatus which, before the introduction of street gas into laboratory use, was a familiar instrument in most analytical laboratories in America. In the Royal Society Catalogue there are sixty-nine titles under Dr. Jackson's name of papers prior to 1863. These are scattered in the pages of many journals and transactions, and relate mostly to mineral analyses. He first demonstrated, by his analysis of the meteoric iron of Alabama, the presence of chlorine as a factor in this class of bodies. He was long an active member, and for many years the

President, of the Boston Society of Natural History, in whose Proceedings many of his contributions appeared. He has for some time been an inmate of an insane asylum, his case being regarded as hopeless.

JAMES BLAKE, of San Francisco, is one of the few chemists in this country who has undertaken researches on the difficult department of physiological chemistry by experiments on the living subject. As early as 1839 he published "Observations on the Physiological Effects of Various Agents Introduced into the Circulation as Indicated by the Hæmadynamometer," and "Experimental Researches on the Mode of Operation of Poisons." Dr. Blake is the pioneer in this line of research.

Dr. Blake has also published "On Electrical Currents Produced during the Process of Fermentation and Vegetation." (*Phil. Mag.*, London, xii. pp. 539–541.)

His important memoir* "On the Effects of Various Saline Substances Injected into the Circulatory System" proves that there exists a close relation between the chemical properties of the substances experimented upon and their physiological effects; his experiments, going to prove that when introduced into the blood substances which are isomorphous exert similar actions on the living tissues; and that salts with the same base have analogous actions.

He tested the action of salts of magnesia, which were found, when introduced in any quantity into the blood, to arrest the action of the heart, with complete prostration of muscular power. The salts of zinc, isomorphous with those of magnesia, have a similar action, but produce the same effects in smaller quantities. The salts of copper, of lime, of strontia, of baryta, and of lead are considered in the order in which they are more closely related by their physiological actions. The peculiar action which the salts of the three last named substances exercise upon the muscular tissues, occasioning contractions in them during many minutes after death produced by their introduction into the blood. These muscular movements were in some cases observed forty-five minutes after the cessation of the heart's action. His experiments on the salts of silver and soda reveal a remarkable similarity in action upon the pulmonary tissue, on the heart, and on the systemic capillaries; for while in the case of all the other salts already mentioned, death seems to be produced by the destruction of the irritability of the heart, the fatal result with the salts of silver and soda is the consequence of their action on the tissues of the lungs. The physiological actions of the salts of ammonia and of potassa were found by Dr. Blake not to correspond with any of the preceding. Although agreeing perfectly with one another in their action upon the heart and the systemic capillaries, they differ extremely in their effects on the nervous tissues, ammonia being particularly distinguished from all inorganic compounds in this respect, and being very analogous to poisons derived from organic products, which it also resembles in its chemical properties. This last observation respecting ammonia, a nitrogenous compound, has received ample confirmation in the researches of later chemical physiologists, and especially in those of Dr. Richardson on the nitrites of the alcohol radicals and of Drs. Crum Brown and Fraser on the salts of the ammonium bases, derived from strychnia, brucia, and other alkaloids.

* Published in the French Archives Générales de Medicine for Nov. 1839. See also Brit. Ass. Rept., 1846, pp. 240–244, and Roy. Soc. Proceedings, iv., 1839, p. 155; Am Journ. Med. Sci., 1849.

Dr. Blake has more recently extended his observations on this interesting subject to embrace the molecular weight as well as the isomorphism of the metallic salts and compounds of some of the metalloids. His paper will be found in the *Am. Jour. Sci.* for March, 1874, and his deductions are:—

1. In the changes induced in living matter by inorganic compounds, the character of the change depends more on the physical properties of the reagent than on its more purely chemical properties.

2. That the character of the changes is determined by the isomorphous relations of the electro-positive element of the reagent.

3. That among the compounds of the more purely metallic elements, the quantity of substances in the same isomorphous group required to produce analogous changes in living matter, is less as the atomic weight of the electro-positive element increases.

4. That the action of inorganic compounds on living matter appears not to be connected with the changes they produce in the proximate elements of the solids and fluids, when no longer forming part of a living body, at least in so far as our present means of research enable us to judge.

5. That in living matter we possess a reagent capable of aiding us in our investigations on the molecular properties of substances.

WOLCOTT GIBBS, Rumford Professor at Harvard College, has published:—

1840. "A Description of a New Form of Magneto-Electric Machine, and an Account of a Carbon Battery of considerable energy, communicated for this journal by Oliver Wolcott Gibbs, member of the junior class in Columbia College." *Am. Journ. Sci.* [1], xxxix. 132. This was the first mention of the use of carbon as the negative element in a voltaic couple.

1845. Dissertation on a Natural System of Chemical Classification. Brochure, New York, and *Am. Journ. Sci.* [1], xlix. 384.

1847. Chemischer-Mineralogischer Untersuchungen. *Pogg. Ann.*, lxxi. pp. 559–67.

1849. Analysis of Dust of a Sirocco which fell at Malta May 16th, 1846. *Sill. Journ.* [2], xi., 374, 1851. Also, *Abhandlungen der Akad.*, Berlin, 1847, and *Pogg. Ann.*, *loc. cit.*

1851. January 1st Dr. Gibbs announced his intention to prepare for the columns of the *American Journal of Science* "Abstracts of the more important physical and chemical papers contained in foreign scientific journals, accompanied by references and by such critical observations as the occasion may demand." *Am. Jour.* [2], xi. 105. This purpose was steadily carried out by Dr. Gibbs for over twenty years; his well-known initials, W. G., appearing in almost every subsequent issue of the *American Journal of Science*, until 1873: an important service to science, the value of which was greatly enhanced by his notes and criticisms, which, of themselves, form a valuable contribution to chemistry. These abstracts and notes cover over 500 closely printed pages. It is far beyond our limits to cite all these "Notes" in detail. They are all referred to in the decade Indices of the *Journal*.

1852. Contributions to Analytical Chemistry. *Am. Journ. Sci.* [2], xiv. 204; also, *Pogg. Ann.*, lxxviii. 162.

1854. Note on a New Electro-Chronometric Method. *Proc. Am. Assn. Adv. Sci.*, viii. 103.

1854. On the Volumetric Determination of Nitric, Arsenic, Antimonic, and Stannic Acids, and on the

Separation of Manganese, Cobalt, and Nickel. *Ibid.*, viii. 247.

1854. On two New General Methods of Chemical Analysis. *Ibid.*, 248. These two papers were read but not printed in the volume of Proceedings, the titles only appearing there.

1855. Report on the Recent Progress of Organic Chemistry. *Ibid.*, ix. 37–61.

1858. On the Theory of the Polyacid Bases. *Ibid.*, xii. 190–197. In this paper the author relegates the discovery of the theory of water-types to Dr. Sterry Hunt; having, in his Report on the Progress of Organic Chemistry, read at Providence, ascribed it to Gerhardt and Williamson.

1858. Preliminary Notice of New Bases, containing Metals Associated with Ammonia. *Ibid.*, xii. 197–200.

1858. On the Rational Constitution of Certain Organic Compounds. *Am. Journ. Sci.* [2], xxv. 18–38.

1857. In joint authorship with F. A. GENTH. "Researches on the Ammonia-cobalt Bases" (for full references see GENTH).

1858. Also with Genth. Preliminary notice of a New Base, containing Osmium and the Elements of Ammonia. *Am. Journ. Sci.* [2], xxv. 248.

1860. Researches on the Platinum Metals (preliminary note.) *Am. Journ. Sci.* [2], xxix. 427.

1861. Remarks on the Atomic Weights of the Elements. *Am. Journ. Sci.* [2], xxxi. 248–256.

1861. Researches on the Platinum Metals. § 1 and § 2. *Am. Journ. Sci.* [2], xxxi. 63–70.

1862. The same continued, § 3. *Ibid.*, xxxiv. 341–356.

1864. The same continued, § 3. *Ibid.*, xxxvii. 57–61.

[This memoir was destined to appear in the Smithsonian Contributions, and was permitted by that Institution to appear in advance in the *Am. Journ. Sci.* Reference to it will be found in Smithsonian Reports for 1859, p. 35, and 1860, p. 39. The conclusion of the research has not yet been published.]

1864. "Contributions to Chemistry, from the Laboratory of the Lawrence Scientific School," viz.:—

1. "On the Relations of Hyposulphite of Soda to certain Metallic Oxides."
2. "On the Determination of Nitrogen by Weight."
3. "On the Separation of Cerium from Didymium and Lanthanum."
4. "On the Separation and Estimation of Cerium."
5. "On the Quantitative Separation of Cerium from Yttrium, Aluminium, Glucinum, Manganese, Iron, and Uranium."
6. "On the Employment of Fluoride of Potassium in Analysis." *Am. Journ. Sci.* [2], xxxvii. 344–358.

1865. "Contributions to Chemistry from the Laboratory of the Lawrence Scientific School, No. 2," viz.:—

1. "On the Separation of Chromium from Aluminium and Iron, etc. etc."
2. "On the Employment of Sodium for the Separation of Iron and Aluminium from other Bases."
3. "On the Separation of Manganese from Cobalt, Nickel, and Zinc."
4. "On the Separation of Cobalt from Nickel."
5. "On the Separation of Uranium from Cobalt and Nickel."
6. "On the Electrolytic Precipitation of Copper and Nickel as a Method of Analysis." *Am. Journ. Sci.* [2], xxxix. 58–65.

1867. On the Construction of a Normal Map of the Solar Spectrum. An abstract of a memoir read before the National Academy of Sciences, Aug. 7, 1866. *Am. Journ. Sci.* [2], xliii. 1–10.

1867. Contributions to Chemistry from the Lawrence Scientific School, No. 3, viz.:—

1. "On a New General Method of Volumetric Analysis."
2. "On the Precipitation of Copper by Hypophosphorous Acid."
3. "On the Precipitation of Copper and Nickel by Alkaline Carbonates."
4. "On the Employment of Sand and Glass Filters in Quantitative Analysis."
5. "On the Estimation of Manganese as Pyrophosphate." *Am. Journ. Sci.* [2], xliv. 207–217.

1867. "On certain points in the Theory of Atomicities." *Ibid.*, pp. 409–416.

1868. "On the Measurement of Wave-lengths by the Method of Comparison." Abstract of a paper read before the National Academy of Sciences, Aug. 16, 1867. *Ibid.*, xlv. 298–301.

1868. "On the Molecular Structure of Uric Acid and its Derivatives." *Ibid.*, xlvi. 289–298.

1869. "On the Wave-lengths of the Spectral Lines of the Elements." *Ibid.*, xlvii. 194–218.

1869. Contributions to Chemistry from the Laboratory of the Lawrence Scientific School, viz.:—

"On the Action of Alkaline Nitrites upon Uric Acid and its Derivatives." *Ibid.*, xlviii. 215–226.

1870. "Contributions to Chemistry, from the Laboratory of the Lawrence Scientific School," viz.:—

1. On a Simple Method of avoiding Observations of Temperature and Pressure in Gas Analysis.
2. On the Application of Sprengel's Mercurial Pump in Analysis. *Ibid.*, xlix. 370–371.

1870. "Miscellaneous Optical Notices." *Ibid.*, l. 45–54.

1873. Analytical Notices, viz.:—

1. On the Quantitative Estimation of Chromium and the Separation of Chromium from Uranium.
2. On the Estimation of Magnesium as Pyrophosphate. *Ibid.* [3], v. 110–117.

1873. "Researches of the Hexatomic Compounds of Cobalt" (being Part II. of the Researches on the Ammonia Cobalt Bases, by Gibbs and Genth). *Ibid.*, vi. 116–126.

1874. The same continued. *Ibid.* [3], viii. 189, 200, and 284–296.

JAMES LAWRENCE SMITH, Louisville, Ky.—Dr. Smith's name appears as a contributor to chemistry as early as 1841, when he wrote "On the Means of Detecting Arsenic in the Human Body," while he was yet a student in medicine in Paris. From that date to the present chemical readers are familiar with his contributions and researches, which have been both varied and important. For some years Dr. Smith was the chemical correspondent of the *American Journal of Science* in Europe. He has quite recently published a volume of his more important papers under the title of "Mineralogy and Chemistry, Original Researches," Louisville, Ky., 1873, 8vo., pp. 401. This volume contains the titles of forty-seven memoirs and papers. It opens with a memoir on Emery communicated to the Academy of Sciences of the French Institute in 1850. Before Dr. Smith's residence in Asia Minor very little was accurately known of the geology, mineralogy, and chemical history of emery. By this memoir, in two parts, we are put in possession of an exact and full history of its geology, mineralogy, and chemical constitution, as well as of that of its associated minerals, with descriptions of new

species, and many chemical analyses. In this research Dr. Smith devised a new method for determining the effective hardness of emery, and adopted, after many trials, the mode of attack by sodic-bisulphate as the only satisfactory means of breaking up the constitution of emery in an ultimate analysis. In the report of the commission of the Academy, Messrs. Cordier, Élie de Beaumont, and Dufrénoy, to whom Dr. Smith's memoir was referred, it is spoken of in terms of high encomium, and its insertion in the *Mémoire des Savants étrangers* was recommended.

In 1866 Dr. Smith extended his researches upon emery and its associate minerals to the interesting mine of that substance at Chester, Mass., first made known by Dr. C. T. Jackson, and this paper properly follows that on the emery of Asia Minor.

The minerals of Chili collected by the Astronomical Expedition to that country under Gillis were submitted to Dr. Smith for examination, and the results appeared in the first volume of Gillis's Report. They are now made accessible in Dr. Smith's volume of Memoirs.

The chemical examination of the "Thermal Waters of Asia Minor" has made known for the first time the constitution of some of the oldest thermals of a district renowned from the earliest historic period as the resort of invalids.

The most extended memoir in Dr. Smith's volume is that on the "Re-examination of American Minerals," which covers 76 pages of the work. The first part of this research was made jointly with Mr. Geo. J. Brush in 1853, at the University of Virginia, where Dr. Smith was then in charge of the chemical chair, and the paper appeared originally in the XVth and XVIth volumes of the *American Journal of Science*, in three parts. It included examinations, with analyses, of thirty-seven mineral species, or reputed species, the joint work of Smith and Brush, forming at the time the most important contribution to mineral chemistry yet made by any American chemists. The subsequent portion of this memoir is occupied with an examination, both physical and chemical, of the minerals of the Wheatley mine, and with the analyses of certain other species, the exclusive work of Dr. Smith. In these analyses the method used for the determination of the alkaline elements is that known as Smith's method, a detailed statement of which is given in a separate paper, pp. 200–221 of this volume, on the "Determination of Alkalies in Minerals," with a supplemental paper on the same subject "by ignition with carbonate of lime and sal-ammoniac" on pp. 293–401. These methods have passed into the literature of analytical chemistry. The American edition of Fresenius, by Johnson, says of the last named process, "Prof. Smith's method is by far the most convenient and accurate for separating alkalies from a silicate, and is universally applicable, except, perhaps, in presence of boracic acid." p. 303, vol. ii.

Dr. Smith's memoirs and researches upon meteorites have added much to our former knowledge of this interesting class of bodies, and are too well known to require more detailed mention here. Over one hundred pages of his volume of "Original Researches" are devoted to these memoirs.

Dr. Smith has added many ingenious appliances to our art in the way of apparatus, none of which is, perhaps, more noteworthy than his inverted microscope for chemical work.

Of his contributions to technical chemistry it is not our purpose to speak here, but his report on the "Progress and Condition of Several Departments of Industrial Chemistry," forming one of the series of documents published by the United States Government on the Paris Exposition of 1867, is familiar to all.

With Dr. Smith's volume of memoirs at hand, it is hardly needful to give here a detailed list of titles of his papers.

TRAILL GREEN, Lafayette College, Easton, Pa.—Prof. Green's papers are as follows:—

On the Atmosphere in Relation to Vegetation.

On Carbon and its Compounds. *The Educator.*

On Humine or Geine, the Food of Plants. *Agriculturist.*

On the Manufacture of Sugar from the Potato.

On Spontaneous Combustion.

MARTIN H. BOYÉ, Ph.D., Philadelphia.—Dr. Boyé's chemical papers have mostly been in joint authorship with others. I find the following titles:—

1846. Acetate of Lime formed in Coal Pits. *Proc. Chem. Phil. Soc.*, iv. 239.

1846. Oxide of Cobalt, with Brown Hematite, of Chester Ridge, Pa. *Ibid.*

1844. Analysis of the Bittern of a Saline on the Kiskiminetas River, near Freeport, Pa. *Sill. Journ.* [2], vii. 74, and *Proc. Am. Asso. Adv. Sci.*, 1848.

1850. Analysis of Schuylkill Water. *Sill. Journ.* [2], lx. 123.

In joint authorship with CLARK HARE.

1842. On the Perchlorate of the Oxide of Ethyl, or Perchloric Ether. *Ibid.* [1], xlii. 63.

1842. On the Perchlorate of the Oxide of Ethyl, or Perchloric Ether. *Ibid.* With R. E. ROGERS.

1842. On Magnesian Limestones. *Journ. Frank. Inst*

1842. On Magnesian Limestones. *Ibid.* With H. D. ROGERS.

1841. New Compound of Deuto-chloride of Platinum, Nitric Oxide, and Chlorohydric Acid. *Am. Phil. Trans.*, viii. 59–65.

1846. New Compound of Deuto-chloride of Platinum, Nitric Oxide, and Chlorohydric Acid. *Ibid.* With C. M. WETHERILL.

1846. Analysis of a Concretion from a Horse's Stomach. *Proc. Am. Phil. Soc.*, ix. 330. With J. C. BOOTH (see under BOOTH).

BENJAMIN SILLIMAN.—Professor of Chemistry, Yale College, New Haven, Conn. His chemical and physical papers are—

1841. Electrography, or the Electrotype. *Am. Journ. Sci.* [1], xl. 157–164.

1841. Analysis of the Soil of the Nile. *Ibid.*, 190.

1842. A Daguerreotype Experiment by Galvanic Light (with Dr. W. H. GOODE). *Ibid.*, xliii. 185.

This experiment was made in 1840, and is the earliest record of the fact, then an unexpected result, that the voltaic arc has photographic efficacy.

1842. On the Use of Carbon in Grove's Battery. *Ibid.*, xliii. 393.

1843. Description of a Carbon Voltaic Battery. *Ibid.*, xliv. 180–186.

1844. Review of Dana's Mineralogy. *Ibid.*, xlvi. 362–388.

1844. Analysis of Meteoric Iron from Burlington, Otsego Co., N.Y. *Ibid.*, xlvi. 401.

1845. Analysis of Blue Mud of New Haven Harbor. *Ibid.*, xlviii. 337.

1845. Notice of a Mass of Meteoric Iron found at Cambria, near Lockport, in the State of New York. *Ibid.*, xlviii. 388–392.

1845. Analysis of the Water of the Dead Sea. *Ibid.*, 10.

1846. On the Chemical Composition of Calcareous Corals. *Ibid.* [2], i. 189–199.

This investigation was undertaken upon the zoophites, collected by Prof. Dana on the Wilkes Exploring Expedition, and appeared in the work on Zoophites by that author. By it the occurrence of phosphoric acid and fluorine as constant factors of these organisms was first demonstrated.

1846. Chemical Examination of Several Natural Waters. (Report of the (Boston) Water Commissioners.) *Ibid.* [2], ii. 218–224.

1846. On the Meteoric Iron of Texas and Lockport (with T. S. Hunt). *Ibid.* [2], ii. 370–376.

1847. Hydrate of Nickel, a New Mineral. (Emerald Nickel.) *Ibid.* [2]. iii. 407.

1847. "First Principles of Chemistry." A chemical manual revised in 1850 and 1853, and in which the fundamental ideas of the so-called "New Chemistry" were first distinctly brought out in a text-book in the organic portion prepared by Dr. Hunt. Over fifty thousand copies of this manual were distributed.

1847. Description (and analysis) of a Meteoric Stone which fell in Concord, New Hampshire, in October, 1846. *Ibid.* [2], iv. 353.

1848. On Chloroform. *Ibid.* [2], v. 240.

1849. On Gibbsite and Allophane, from Richmond, Mass. *Ibid.* [2], vii. 411–417.

1849. Description and Analysis of Several American Minerals. The subjects treated of in this article are as follows:—

I. Description and Analyses of Several Mineral Species belonging to the family of Micas.

II. Description and Analyses of Unionite, a new mineral species.

III. Description and Analyses of a Species resembling Worthite.

IV. Identity of Sillimanite, Bucholzite, and Fibrolite with Kyanite.

V. Analysis of a Granular Albite, associated with Corundum of Pennsylvania, and a new Analysis of the Indianite of Bournon.

VI. On Boltonite and Thomson's Bisilicate of Magnesia.

VII. On Nuttalite of Brooke.

Ibid. [2], viii. 377–394.

1850. On the New Mineral Lancasterite. *Ibid.*, ix. 216.

1850. Optical Examination of Several American Species. *Ibid.* [2], 372–383.

In this memorial the specific characters of Muscovite, Phlogopite, and Biotite, were first distinctly demonstrated as resting on optical phenomena.

1850. Analysis of Emerylite. *Ibid.*, p. 117.

1851. On Mammoth Cave. *Ibid.* [2], xi. 332–340.

1852. Daguerreotypes by Galvanic Light. *Ibid.*, 417.

1852. An Excursion on Etna. *Ibid.* [2], xii. 178.

1857. Notice of a Photometer, and of some Experiments therewith upon the Comparative Power of several artificial means of Illumination (with Chas. H. Porter). *Ibid.* [2], xxiii. 315.

1858. First Principles of Natural Philosophy, and—

1860. New edition of the same.

1859. Meteor of Aug. 11, 1859. *Ibid.* [2], xxviii. 300.

1860. On the Combustion of Wet Fuel in the Furnace of Moses Thompson. *Ibid.* [2], xxx. 243–253.

1860. Note on the Loss of Light by Glass Shades. *Ibid.*, 423.

1865. Examination of Petroleum from California. *Ibid.*, xxxix. 341.

1866. On Gaylussite from Nevada Territory. *Ibid.* [2], xlii. 220.

1867. On Naphtha and Illuminating Oil from heavy California Tar (Maltha). *Ibid.* [2], xliii. 242.

1869. On the Effect of Atmospheric Air when mixed with Gas in Reducing its Illuminating Power. (Joint paper with H. Wurtz.) *Ibid.* [2], xlviii. 41.

1869. Note on Wollongonite, a remarkable Hydrocarbon from N. South Wales. *Ibid.*, 85.

1870. On the Relation between the Intensity of Light produced from the Combustion of Illuminating Gas and the volume of Gas consumed. *Ibid.* [2], xlix. 17–24.

1870. On Flame Temperatures in their Relations to Composition and Luminosity (jointly with Henry Wurtz). *Ibid.*, 339–347.

1870. Note on Mr. Stimpson's Paper on Farmer's Theorem. *Ibid.* [2], 377.

1870. On the Determination of the Photometric Power of a Rich Gas by Dilution with a Poor Gas of known value. *Ibid.*, 379.

1873. On the Meteoric Iron found near Shingle Springs, Eldorado County, California. *Ibid.* [3], 18.

1873. Mineralogical Notes on Utah, California, and Nevada, with a description (and analyses) of Priceite, a new Borate of Lime. *Ibid.*, 126–133.

1874. Mineralogical Notes. Tellurium ores from Colorado. *Ibid.* [3], 25.

In the *Amer. Chemist*, July, 1871, vii. p. 18, 23:—

1871. "Report on the Rock Oil, or Petroleum, from Venango County, Pa."

This is a reproduction of a printed but unpublished report of 1855 (April), which is believed to be the earliest investigation into the chemical and physical properties of American petroleum, then collected only in surface pools, of a dark color and viscous quality, long before any Artesian borings had made known the vast extent and importance of this remarkable product.

F. A. P. Barnard, D.D., LL.D., President of Columbia College, New York. Nearly all Dr. Barnard's contributions to science, which are numerous and important, are physical. We note the following papers as falling within the scope of this essay.

1841. Improvement in the Daguerreotype process of Photography. *Am. Journ. Sci.* [1], lxi. 352.

1859. Means of preventing the Alteration of Metallic Surfaces as employed to close and break a voltaic circuit. *Proc. Am. Assn. Adv. Sci.*, vol. xiii. 1819, 208–216.

Fredk. A. Genth, Professor of Chemistry and Mineralogy in the University of Pennsylvania, has no superior in this country as an analytical chemist. His early chemical papers are to be found in the European journals, before his coming to America, in Berzelius's Jahresbericht; Liebig's Annalen; in Leonhard and Bronn's Jahrbuch; in Erdmann's Journal, and also in the German-American Keller-Tiedemann's Monatsbericht, etc. In Keller-Tiedemann's Monatsbericht appeared the first description of the ammonia cobalt bases, which he had discovered in Germany, in 1846. His first paper which I have seen is, "Chemische Unterschung des Masopins eines neuen Hartzartigen Körpers," in Wöhler and Liebig's Annalen, 1843, 116–124.

Dr. Genth has published most of his papers since coming to the United States in the *Am. Journ. of Sci.*

1853. "On the Allotropic Modification of Oxide of Cobalt" [2], xv. 120. "This corresponds to the allotropic modification of oxide of nickel," first noticed by Dr. Genth in 1845. *Ann. der Chem. und Pharm.*, liii. p. 139.

1853. "On a probable New Element with Iridosmine and Platinum, from California." [2], xv. 246.

1853. "On Rhodophyllite," xv. 438, and *Proc. Acad. Nat. Sci.* Phila. 1852. 121.

1853. "Contributions to Mineralogy: 1. Tetradymite: 2. Gray Copper: 3. Apophyllite; 4. Allanite" [2]. xvi. 81–86. and continued: "5. Owenite; 6. Kämmerite. Emerald. Nickel." *Ibid.*, 167.

1854. "Contributions to Mineralogy: 1. Pyrophyllite: 2. Chrysotile; 3. Scolecite; 4. Owenite, identical with Thuringite" [2]. xviii. 410. and continued: "5. Tetradymite; 6. Bismuthine: 7. Aciculite; 8. Barnhardite, a new mineral; 9. Gray Copper (Fahlerz); 10. Geokronite: (?) 11. Garnet; 12. Allanite: 13. Tungstates of N. Carolina; 14. Scorodite: 15. Wavellite." [2], xix. 15. In all these "contributions" are numerous and exhaustive analyses of minerals.

1854. "On a New Meteorite from New Mexico." xvii. 239.

1855. "Analysis of a Meteorite from Tuczon. Province of Sonora, Mexico." [2], xx. 110. Also in *Pro. Acad. Nat. Sci.*, vii. 317.

1855. "Herrerite identical with Smithsonite." *Ibid.*, 118.

1857. "Contributions to Mineralogy: 1. Bismuthine from Riddwehyttan in Sweden; 2. Harrisite (Shepard), a Pseudomorph of Copper Glance after Galena; 3. Cantonite. a Pseudomorph of Covelline after Galena: 4. Linnæite; 5. Enargite; (?) 6. Coracite (LeConte) is Pitch blende; 7. Epistilbite; 8. Shepard's Plumbo-Resinite is Cyanosite: 9. Cherokine (Shepard) is Pyromorphite: 10. Vivianite: 11. Wavellite; 12. Dufrenite: 13. Hitchcockite (Shepard); 14. Lanthanite; 15. Bismuthite." [2]. xxiii. 415–427.

1857. In joint authorship with Wolcott Gibbs.

"Researches on the Ammonia-cobalt Bases. Part I." [2]. xxiii. 234–265. *Ibid.*, 319–341; concluded in xxiv. 86–107. This memoir, more elaborate and fuller of new results than any chemical research before accomplished in this country, and which occupied the leisure of the authors for several years. formed part of the ninth volume of the "Smithsonian Contributions to Knowledge," from which it was reprinted as above.

1859. "Contributions to Mineralogy: Whitneyite, a New Species." [2]. xxvii. 400.

1859. "Contributions to Mineralogy; 1. Native Iron: 2. Native Bismuth; 3. Whitneyite: 4. Barnhardite: 5. Gersdorffite; 6. Molybdate of Iron: 7. Albite; 8. Ripidolite; 9. Pholerite: 10. Scheelite; 11. Rhombic Tungstate of Lime; 12. Wolfram; 13. A few observations on the occurrence of gold." [2], xxviii. 246–255.

1862. "Contributions to Mineralogy: 1. Gold, pseudomorph after Aikinite; 2. Antimonial Arsenic and Arsenolite: 3. Arsenids of Copper: 4. Copper Glance, pseudomorphous after galena: 5. Millerite: 6. Proustite: (?) 7. Automolite; 8. Pyrope; 9. Lime Epidote; 10. Leopardite, a true porphyry; 11. Staurotide (?); 12. Chrysolite and Minerals resulting from its alteration: 13. Serpentine; 14. Kerolite: 15. Rammelsberg's Mineral Chemie." [2], xxxiii. 190–206.

1868. "Contributions to Mineralogy, No. VII.—1. Whitneyite: 2. American Tellurium Minerals. In this paper is described *Melonite*, a new mineral, Ni_2Te_3(?) *Calaverite*, a new mineral, Au Te_4: *Montanite*, a new mineral $BiO_3TeO_3 2HO$; and *Cosalite*, a new mineral $2PbS + BiS_3$. This paper, like all the former numbers of this series, has numerous analyses.

1870. "North Carolina's Mineral Resources, etc." *Franklin Inst. Journ.*, 18,1 and 1872.

1874. "Contributions from the Laboratory of the University of Pennsylvania."

I. "Corundum, its alterations and associated minerals," *Proc. Am. Phil. Soc.*, September 19, 1874, p. 56, with many analyses.

There are a few other notices in the *Pro. of the Acad. Nat. Sci.*, and, on the occurrence of tin in America, in the U. S. Railroad and Mining Register, which we have not enumerated.

Henry How, D.C.L., Professor of Chemistry and Natural History University of King's College, Windsor, N. S., has published the following papers on chemistry and chemical mineralogy:—

1. Analysis of Ancient Peruvian Alloy. Read before Chemical Society of London, and published in their *Journal*, 1846.

2. Analysis of the Ashes of the Orange Tree, viz., of Root, Stem, Leaves, Fruit, and Seed, in conjunction with T. H. Rowney. Read before Chem. Soc. Lond., and published in their *Journal*, 1847.

3. Analyses of Coals of Great Britain, etc. Published in Blue Books for Houses of Parliament, containing reports by Sir H. De La Beche and Dr. Lyon Playfair on Coals suited to the Steam Navy, 1848–49.

4. On certain Salts and Products of Decomposition of Comenic Acid. Read before Roy. Soc. Edin., and published in *Transactions*, 1851.

5. On the Decomposition of Citrate of Lime in contact with Putrefying Curd. Read before Chem. Soc. Lond., and published in their *Journal*, 1851.

6. On Meconic Acid and some of its Derivatives. Read before Roy. Soc. Edin., and published in *Transactions*, 1852.

7. On some New Basic Compounds, obtained from Vegetable Alkaloids. Read before Chemical Soc. Lond., and published in their *Journal*, 1853.

8. On Platinum accompanying Silver in Solution in Nitric Acid. Read before Chemical Soc. Lond., and published in their *Journal*, 1853.

9. Report on Torbane Hill Mineral, so-called Coal, for the Instruction of Counsel in the case of Gillespie *v.* Russell. Edin., 1853.

10. On the Action of Halogen Compounds of Ethyl, and Amyl, on some Vegetable Alkaloids. Read before Roy. Soc. Edin., and published in *Transactions*, 1854.

11. On the Hyposulphites of the Organic Alkaloids. *Edin. New Phil. Journ.*, 1855.

12. Additional Experiments on the Ethers and Amides of Meconic and Comenic Acids. *Edin. New Phil. Journ.*, 1855.

13. On the Occurrence of the Mineral Natro-boro-Calcite in Gypsum of Nova Scotia. *Am. Journ. Sci.*, and *Edin. New. Phil. Journ.*, 1857.

14. Chemical Analyses of Faröelite and some other Zeolitic Minerals occurring in Nova Scotia. *Am. Journ. Sci.*, 1858.

15. Analysis and Description of Three New Minerals from Trap of Bay of Fundy. *Edin. New Phil. Journ.*, 1859.

16. On an Oil-Coal from Pictou Co., N. S., and the Comparative Composition of Minerals often included in the term "Coals" *Am. Journ. Sci.*, and *Edin. New Phil. Journ.*, 1860.

17. On the mineral Gysolite occurring in Trap of Bay of Fundy. Read before Roy. Soc. Edin.; published in *Am. Journ. Sci.*, and *Edin. New Phil. Journ.*, 1861.

18. On Natro-boro-Calcite and another Mineral, con-

taining Boracic Acid in Gypsum of Nova Scotia. Read before Roy. Soc. Edin.; published in *Am. Journ. Sci.*, and *Edin. New Phil. Journ.*, 1861.

19. On Pickeringite occurring in Slate in Nova Scotia, and on the Class of Salts to which it belongs. Read before Chem. Soc. Lond. and published in *Qu. Journ.*, 1863.

20. On some Mineral Waters of N. S. Read before Nat. Hist. Soc. Montreal; pub. in *Canadian Naturalist*, 1863.

21. On the Waters of the Mineral Springs of Wilmot, N. S. Read before N. S. Inst. Natural Science; pub. in *Transactions*, 1864.

22. On Mordenite; a New Mineral from Trap of N. S. Read before Chem. Soc. Lond.; pub. in *Qu. Journ.*, 1864.

23. Notes on the Economic Mineralogy of Nova Scotia, Part I., Iron Ores. Read before N. S. Inst. Nat. Sci.; published in *Transactions*, 1864.

24. Note on Purification of Oxalic Acid. *Chemical News*, 1864.

25. On a Dense Brine from Salt Springs, N. S. Read before Chemical Soc. London; published in *Journal*, 1865.

26. On some Brine Springs of Nova Scotia. Read before N. S. Institute Nat. Sci.; pub. in *Transactions*, 1865.

27. Notes on Economic Mineralogy N. S., Part II. Ores of Manganese. Read before N. S. Inst.; pub. in *Transactions*, 1865.

28. Notes on Econ. Min. N. S., Part III. Limestone and Marbles. Read before N. S. Inst.; published in *Transactions*, 1866.

29. On the Comparative Composition of some Recent Shells, a Silurian Fossil Shell, and Shell Limestone of Carboniferous Age. *Am. Journal of Science*, 1866.

30. Contributions to the Mineralogy of N. S., Part I., Pyrolusite, etc. *Lond., Edin., and Dub. Phil. Mag.*, 1866.

31. Contributions to the Mineralogy of N. S., Part II., Wichtyne, etc. *Lond., Edin., and Dub. Phil. Mag.*, 1867.

32. Contributions to the Mineralogy of N. S., Part III., Silico-boro-calcite, etc. *Lond., Edin., and Dub. Phil. Mag.*, 1868.

33. Notes on Econ. Min. N. S., Part IV., Gypsum and Anhydrite. Read before N. S. Inst. Nat. Sci.; pub. in *Transactions*, 1868.

34. On an Oxalate of Manganese. *Chemical News*, 1869.

35. On the New Precipitation of Manganese by Sulphide of Ammonium in Presence of some Organic Ammoniacal Salts. *Chem. News*, 1869.

36. Mineralogy N. S. Report to Provincial Government, pp. 217; Halifax, 1869.

37. Contributions to Mineralogy N. S., Part IV., Lignite, etc. *Lond., Edin., and Dub. Phil. Mag.*, 1869.

38. Notes on Econ. Min. N. S., Part V., Coals and Allied Minerals. Read before N. S. Inst. Nat. Sci.; pub. in *Transactions*, 1869.

39. Contributions to Mineralogy N. S., Part V., New Forms of Borates, etc. *Lond., Edin., and Dub. Phil. Mag.*, 1870.

40. Contributions to Mineralogy N. S., Part VI., Winkworthite, etc. *Lond., Edin., and Dub. Phil. Mag.*, 1871.

41. On an Acid Feed Water from Stellarton, N. S. Read before Chem. Soc. Lond.; published in their *Journal*, 1870.

42. On a Water from Coal Measures at Westville, N. S. Read before Chem. Soc. Lond.; pub. in their *Journal*, 1871.

43. On Two Coals from Cape Breton, their Cokes and Ashes, with some Comparative analyses. Read before Chemical Society London; published in *Qu. Journal*, 1874.

THOMAS STERRY HUNT, Professor of Geology at the Massachusetts Institute of Technology, Boston.—The name of no American chemist occurs more frequently, or in a more important relation to the progress and development of our science, during the past quarter of a century than that of Dr. Hunt. His contributions to our science have been equally valuable in theoretical chemistry, in chemical philosophy, and in geological and mineralogical chemistry. No author has covered a wider range than he. Not less than one hundred and thirty entries are found under his name in the second and third series of the *American Journal of Science;* and adding those published in Canada, England, and France, and some memoirs in the proceedings of various American societies, the total roll of his papers amounts to about one hundred and sixty titles. A dry enumeration of these would be of little interest; we will rapidly allude to a few of them in the classified order named below.

I. *Theoretical Chemistry.*—The views of Laurent and Gerhardt found their first advocacy in this country at the hands of Dr. Hunt in his able review of the *Précis* of the latter in 1847 (*Amer. Journ. Sci.* [2], iv. 93–171), and his own papers in the years next following have contributed in no small degree to extend the bounds of theoretical chemistry and its philosophy. We mention in particular his paper "On the Anomalies in the Atomic Volume of Sulphur and Nitrogen," in 1848 (*Amer. Journ. Sci.* [2], vi. pp. 170–178). This paper contains also remarks on Chemical Classification and a notice of Laurent's Theory of Binary Molecules. In his paper, 2. "On some Principles to be considered in Chemical Classification," read at the Philadelphia meeting of the American Association, etc., in 1848, Dr. Hunt freely criticizes the systems of Liebig and of the French school, the rather to show their merits than their defects, and to exhibit their real harmony with each other and with nature. In this paper he advances his own views, showing what we all now recognize as the true constitution of gaseous nitrogen—NN—and that the various saline forms are reducible to two, the types of which are seen in water, H_2O, and the protoxyds, M_2O, and in the hydrogen, H_2, or the metals M_2, the first including all the oxygenized acids, and the second, the hydracids. 3. "On the Chemical Constitution of Gelatine and its Transformations."

4. "Remarks on the Constitution of Leucine and the Ureas" (*American Journal of Science* [2], ix. 63–67).

5. "On the Compound Ammonias and the Bodies of the Cacodyle Series," published in 1852 (*Amer. Journ. Sci.* [2], xiii. 206–211).

6. "On the Action of Sulphuretted Hydrogen upon Nitric Acetene," published in 1847, *Amer. Journ. Sci.* [2], iv. 350.

7. "On the Decomposition of Aniline by Nitrous Acid."

The last investigation points out a new mode of decomposition of organic bases, and in the case cited phenol was regenerated.

8. "On the Theoretical Relations of Water and Hydrogen." In this paper, published in March, 1854, Dr. Hunt reviews the opinions of the European chemists on the water-type, and reclaims (Dec. 30, 1853) for

himself the priority of authorship in this important conception which the English edition of Gmelin's Handbook (vol. vii. pp. 17 and 201) ascribes to Williamson.

9. "On the Theory of Types in Chemistry," is the title of a memoir of Dr. Hunt's, dated January 5, 1861 (*Amer. Journ. Sci.* [2], xxxi. pp. 256–263), in which he ably reviews the history of the subject, and shows that in the series of papers whose titles are above quoted, 1 to 9, were first developed the views of the *water-type* and of *multiple or condensed types* which were subsequently adopted by Williamson, Gerhardt, and Ad. Wurtz. Dr. W. Gibbs, in an essay presented by him at the Baltimore meeting of the American Association for Ad. Science, May, 1858, remarks that in a previous paper of his (his "Report on the Progress of Organic Chemistry"), he had attributed the theory of water-types to Williamson and Gerhardt, and adds, "in this I find I have not done justice to Mr. T. Sterry Hunt, to whom is exclusively due the credit of having first applied the theory to the so-called oxygen-acids and to the anhydrids, and in whose earlier papers may be found the germs of most of the ideas on classification usually attributed to Gerhardt and his school."

10. "Theory of Nitrification and Nature of Gaseous Nitrogen" (*Amer. Journ. Sci.*, 1848), further developed with experiments on the oxidation of nitrogen by permanganic acid, and the origin of nitrous acid, forming a key to the true origin of nitrites and nitrates in nature. This view was adopted without change or addition by Schönbein in 1862, and without acknowledgment. See Hunt's Reclamation in the *Amer. Journ. Sci.* [2], xxxv. pp. 271–273, 1863.

Other views of fundamental importance have been put forth by Dr. Hunt on Theoretic Chemistry, but we must pass them and make brief mention of some of his more important contributions to—

II. *Chemical Philosophy.*—1. "Considerations on the Theory of Chemical Changes, and on Equivalent Volumes." This paper appeared in 1852 (*Amer. Journ. Sci.* [2], xv. 226), and is a more condensed statement of the same views developed by the author in an "Introduction to Organic Chemistry," which appeared in Silliman's Chemistry in the same year.

2. "Thoughts on Solution and the Chemical Process" (*Amer. Journ. Sci.* [2], xix. 100). In this paper the ground is taken that all solution is chemical union.

3. "On the Objects and Method of Mineralogy" (*Amer. Journ. Sci.*, [2], xliii. 203.)

4. "On the Constitution and Equivalent Volume of some Mineral Species." This is an elaborate memoir (*Amer. Journ. Sci.*, Sept. 1853), in which the author develops his views respecting the homology of chemical formulas, and the similarity of volume in isomorphous species, looking to an enlargement and simplification of the plan of chemical science, and leading to a correct mineralogical system.

5. "Illustrations of Chemical Homology." In this paper, read at Washington, in 1854, before the American Association for Advancement of Science (viii. 237), the author gives a greater extension to his former paper just named (4) and discussed many points with regard to the homologies of organic and mineral species. Here will be found developed his views on the constitution of the feldspars, which were some years later adopted without acknowledgment by Tschermak.

Besides these contributions already cited, Dr. Hunt has been a constant worker in the analyses of minerals, and has made many important—

III. *Studies in Geological and Mineralogical Chemistry.*—We can only mention in passing:—

1. Analyses of Warwickite, Columbite, Samarskite, Rutherfordite, in early volumes of the *Amer. Journ. Science*.

2. On Euphotide, Saussurite, and related Diorites, an elaborate study with many analyses, published in 1859 in the *Amer. Journ. Science.*

3. On the Labrador Feldspars, printed in the *London Phil. Magazine* for 1855.

4. Contributions to the Chemistry of the Ophiolites, vols. xxv. and xxvi., *Amer. Journ. Sci.*, 1858. An elaborate research with numerous analyses forming part of the Geological Reports of Canada.

5. "Contributions to Lithology. I. Theoretical Notions. II. Classification and Nomenclature. III. On some Eruptive Rocks" (*Amer. Journ. Sci.* [2], xxxvii. 248, and xxxviii. 91 and 248, 1864). This elaborate memoir gives the composition of the various eruptive rocks of the district of Montreal, with the author's theoretical deductions therefrom.

6. "Contributions to the History of Natural Waters" (*Amer. Journ. Sci.*, 1865). In this memoir is given the theory of the origin of mineral-waters, with studies of their composition, illustrated by the waters of the St. Lawrence basin, and the chemical relations of each element. This research is in part in the Geological Survey of Canada for 1867.

7. "On Some Reactions of the Salts of Lime and Magnesia and on the Formation of Gypsum and Magnesian Rocks" (*Amer. Journ. Sci.*, 1859). This very elaborate memoir exhibits a great amount of chemical work, and treats—I. of the action of solutions of bicarbonate of soda on salts of lime and magnesia. II. On the reaction between solutions of bicarbonate of lime and the sulphates of soda and magnesia. III. On the formation of double carbonate of lime and magnesia. IV. Facts in the history of gypsums, dolomites, magnesites, and limestones. V. On the mode of formation of the preceding rocks. This was followed by a supplementary paper, entitled "Farther Contributions to the Chemistry of Lime and Magnesia Salts" (*Amer. Journ. Sci.*, 1866).

In this connection it is but just to mention that in addition to the work here recorded, Dr. Hunt has in the volumes of the Geological Survey of Canada given analyses of a vast number of rocks, soils, ores, etc., contributions toward the chemistry of ore-deposits in Canada, etc.

But time fails us even to name the work of Dr. Hunt in many other important researches of a like nature. "Researches on the Artificial Production of Earthy Silicates, and some points in Chemical Geology and the Chemistry of the Metamorphic Rocks," published in the *Quarterly Geological Journal*, London, from 1859 to 1863. His "Chemical Theory of the Globe;" "The Chemistry of Chaos;" "Chemical Origin of Rocks, Sea, Atmosphere, Ore Deposits, Mineral Species, Volcanoes," developed in various papers in the *Amer. Journ. Sci.*, the *Smithsonian Report* for 1869, and the author's address at Indianapolis before the American Association for the Advancement of Science, on the "Origin of Crystalline Rocks," and his "Contributions to the Chemistry of Copper" (*Amer. Journ. Sci.*, 1870).

A volume containing some of the more important of Dr. Hunt's original papers here enumerated, and others, is now in press, and will soon appear, simultaneously, in Boston and in London.

JOHN L. LECONTE, M.D., Philadelphia.—This eminent naturalist made his inaugural dissertation on a

chemical investigation, which has been published as follows:—

On a New Species of Urinary Concretions, by John L. LeConte, M.D. *New Journal of Medicine and the Collateral Sciences*, 1846, vol. vii. p. 172.

E. N. HORSFORD, Cambridge, Mass.—Prof. Horsford's chemical papers are as follows:—

1846. Uber den Werth Verschiedener Vegetabilischer Nahrungsmittel, hergeleit aus ihrem Stickstoffgehalt *Liebig's Annal.*, lxiii. 166, translated in *Sill. Journ.*, ii. 264.

1846. Analyse der Ashe des Kleies Trifolium praetense. lviii. 391, *Liebig Annal.*

1846. Uber den Ammoniakgehalt der Gletscher. *Liebig Annal.*, lix. 113.

1846. Uber Glycocoll (Leimzucker) und einige seiner Zersetzungs producte. *Liebig Annal.* lxi. Translated in *Sill. Journ.*, iii. 369, iv. 58, 326.

1846. List of Sweet Bodies. *Proc. Am. Acad.*, i. 303. Chemical Essays Relative to Agriculture. *Sill. Journ.*, ii. 144.

1847. Warrentrapp and Will's Method for the Determination of Nitrogen improved. *Sill. Journ.* [2], iv. 267.

1848. Strecker's Researches on Ox-gall. *Ibid.* [2], v. 17.

1848. Resistance presented to Fluids by Electric conduction. *Ibid.* [2], v. 36.

1848. New Blast Lamp. v. 36, *Ibid.* [2].

1848. Liebig's New Mode of separating Nickel and Cobalt. *Ibid.* [2], v. 411.

1848. On Motions of Fluids in Animal Bodies. *Ibid.* [2], v. 415.

1848. Contamination of Water, etc. *Am. Acad. Proc.*, ii. 62–99.

1848. Explosion of Burning Fluids. *Proc. Am. Ass.*, ii. 178, 179.

1849. On the Moisture, Ammonia, and Organic Matters of the Atmosphere. *Ibid.*, ii. 124, *Liebig Annal.*, lxxiv. 243, 1850.

1849. Note on Soda in the Ashes of Anthracite Coal. *Proc. Am. Ass.*, 233.

1849. On Color of Fused Sulphur. *Proc. Am. Ass.*, 234.

1851. Occurrence of Placid Waters in the Midst of large Areas where Waves are constantly breaking. vi. 41. *Proc. Am. Ass.*

1850. On the Relation of Barium, Strontium, etc. *Sill. Journ.* [2], ix. 176.

1851. Plasticity of Sulphur. *Proc. Am. Ass.*, vi. 63.

1851. Relation of Chemical Constitution to Light. *Proc. Am. Ass.*, 74.

1856. Ammonia in the Atmosphere. *Ibid.*, x. 145.

1863. Salts of Zinc, Aluminium, Sodium, Potassium. *Mem. Am. Acad.*, viii. 354–360.

1851. Analyses of Teas. *Sill. Journ.* [2], xi. 249.

1851. Relation of Chemical Constitution to taste. *Ibid.* [2], xii. 195.

1852. Permeability of Metals to Mercury. *Ibid.* [2]. xiii. 305.

1853. Solidification of the Coral Reefs of Florida, and the Source of Carbonate of Lime in the Growths of Corals. *Proc. Am. Ass.*, vii. 122.

1868. Source of Free Hydrochloric Acid in Gastric Juice. *Ibid.*, xvii. 178.

1868. Phosphoric Acid a Constituent of Butter. *Ibid.*, xvii. 114.

1869. Phosphoric Acid, Iron, and Potassium, Constituents of Chlorophyl. *Ibid.*, 147.

JOHN W. MALLETT, Professor of Chemistry in the University of Virginia, at Charlottesville, Va., has for many years been an industrious worker, publishing original researches on chemical subjects, which form important contributions to our science. The destruction of the buildings of the University of Alabama, by the Federal Cavalry during the late civil war, has deprived Prof. Mallett (who was formely Prof. of Chemistry at Tuscaloosa) of all means of responding to the call for his papers, but the following list is as complete as it could be conveniently made by us from the materials at hand.

1850. On the Minerals of the Auriferous Districts of Wicklow. *Phil. Mag.* [3], xxxvii. 392.

1845. Chemical Examination of Killinite. *Dub. Geol. Soc.* iv. *Chemist*, I. 47–49, 1849–50.

1851. Occurrence of Gadolinite in Ireland. *Phil. Mag.* [4], i. 350.

1851. Beobachtungen über das Telluräthyl. *Liebig Ann.* [4], xxix. 223.

1852. On a New Fossil Resin. *Phil. Mag.* [4], iv. 261.

1853. Analysis of Euclase. *Phil. Mag.* [4], v. 127.

1853. On a Siliceous Deposit from the Hot Volcanic Springs of Taupo. *Phil. Mag.* [4], v. 285.

1854. Analysis of Tin Pyrites. *Sill. Journ.* [2], xvii. 23.

1854. Analysis of Idocrase from Ducktown, Polk Co., Tenn. *Ibid.* [2], xx. 85.

1854. On Phosphates of Iron and Manganese from Norwich, Mass. *Ibid.* [2], xviii. 33.

1855. On Crystallization of Platinum from Fusion. *Ibid.* [2], xv. 340.

1856. Redetermination of Lithium. *Am. Assn.*, x. 144.

1856. On a Zeolitic Mineral from the Isle of Skye. *Phil. Mag.* [4], xii. 406–552.

1857. Atomic Weight of Aluminium. *Brit. Assn. Report*, p. 53.

1857. On the Atomic Weight of Lithium. *Phil. Mag.* [4], xiii.

1857. Results of some Analyses made for the Geol. Survey of Alabama. *Sill. Journ.* [2], xxiii. 181.

1857. Notice of a supposed new case of Fluorescence. *Ibid.* [2], xxiii. 434.

1857. On the Separation of Lithia and Magnesia. *Ibid.* [2], xxiii. 427.

1857. On the Rose-colored Mica of Goshen, Mass. *Ibid.* [2], xxiii. 180.

1857. Separation of Magnesia and Lithia. *Ibid.* [2], xxiv. 137.

1858. Schrotterite from Cherokee Co., Alabama. *Ibid.* [2]. xxvi. 79.

1859. On Brewsterite. *Ibid.* [2], xxviii. 48.

1860. Metallic Copper and Dinoxyd of Copper. *Ibid.* [2], xxx. 253.

1859. Nitrate of Zirconium. *Am. Assn.*, xiii. 217.

1859. Atomic weight of Lithium. *Am. Assn.*, xiii. 221.

1860. Osmious Acid and the position of Osmium in the list of elements. *Phil. Mag.* [4], xix. 293.

1861. Chemical and Physical Conditions of the Culture of Cotton. *Proc. Royal Soc.*, xi. 340.

J. D. WHITNEY, Cambridge, Mass.—Mr. Whitney's chemical work has been in mineral chemistry. He has published as follows:—

1849. Examination of American Minerals. *Sill. Journ.* [2], vii. 433, 434. *Proc. Boston Nat. Hist. Soc.* 1849, p. 48.

1849. On some Silicates containing Carbonic Acid, Chlorine, and Sulphuric Acid. *Sill. Journal*, vii. 435. *Pogg. Ann. der Ph. und Ch.*, lxx. 431.

1849. On Chloritoid and Masonite; and Black Oxide of Copper. Lake Superior. *Sill. Journ.* [2], viii. 273. *Proc. Boston Nat. Hist. Soc.* 1849, p. 100.

1854. Analysis of Algerite and Apatite. *Sill. Journ.*, xvii. 206.

1860. On Pectolite. *Ibid.* [2], xxix. 205.

1860. Analysis of Pyroschists. *Ibid.*, lxvi. 160.

William Phipps Blake has written chiefly on geological and kindred topics; but we find in 1850 an article by him on the "Occurrence of Crystallized Oxyd of Chromium ($\overline{C}r$) in Furnaces for the Manufacture of Chromate of Potash," giving the crystallographic and other physical characters of the substance. *Am. Jour. Sci.*, 2, x. No. 30, Nov. 1850.

Mr. Blake was the first to recognize the *tellurids* among the mineral products of California. His Report on the Precious Metals, forming one of the governmental volumes on the Paris Universal Exposition of 1867, is replete with valuable information. Mr. Blake first drew attention to the platinum metals associated with the gold washings of California, and published an analysis of the mass made for him in Dr. Genth's laboratory in 1854. "Report of a Geological Reconnaissance of California," 4to. pp. 300.

1850. "On Dimorphism of Copper," *Am. Ass. Proceedings*, iv. p. 151.

1850. "New Instrument for Measuring the Angles contained between the Optic Axes of Crystals and for Goniometrical Purposes," *Ibid.*, pp. 378–221.

John M. Ordway, Chemical Laboratory of the Massachusetts Institute of Technology, Boston.—All of Prof. Ordway's papers, with a single exception, have been published in the *Am. Journ. of Sci.*, 2d series. They are as follows:—

Memoirs.

1850. Nitrates of Iron, Alumina, and Chromium. *Am. Journ. Sci.*, ix. 30.

1865. Nitrates of Iron. *Id.*, xl. 316.

1859. Some Facts respecting the Nitrates. *Id.*, xxvii. 14.

1857. Some Soluble Basic Salts of Tin. *Id.*, xxiii. 220.

1858. Examination of the Soluble Basic Sesquisalts. *Id.*, xxvi. 197.

1858. A new Mode of making Commercial Caustic Soda. *Id.* xxvi. 364.

1861–1865. On Waterglass, a series of five articles. *Id.*, xxxii. 153, 337; xxxiii. 27; xxxv. 185; xl. 173.

Reviews.

1856. Wetherill's Manufacture of Vinegar. *Am. Journ. Sci.*, xxxi. 450.

1867. Schützenberger's Traité des Matières Colorantes. *Id.*, xliii. 421.

1867. Mulder's Die Chemie der auströckende Oele. *Id.*, xliv. 438.

1868. Assmass' Die Trockne Destillation des Holzes. *Id.*, xlv. 274.

Obituary Sketches.

1868. Dr. S. L. Dana. *Id.*, xlv. 424. Author of the same in *Proc. Am. Acad. Arts and Sci.*, viii. 26.

Wm. H. Brewer, New Haven, Connecticut.—Prof. Brewer's contributions to chemistry are:—

1850. Determinations of Nitrogen in two Varieties of Indian Corn. *Proc. Am. Assoc. Adv. Sci.*, iv. 386.

Prof. Brewer has also contributed Analysis of Minerals to Dana's Mineralogy, etc.

George J. Brush, Sheffield Scientific School, New Haven.—All the chemical researches of Prof. Brush fall under the head of chemical mineralogy, to which he has made important contributions. Besides the subjoined list, he has contributed analyses of minerals to the third, fourth, and fifth editions of Dana's *Mineralogy*, and to the various supplements. Of the latter he edited the eighth, ninth, and tenth, published in the *American Journal of Science*, and also the appendix to the fifth edition, recently published by Wiley. So large a part of the work of American chemists has been devoted to mineralogy, which, in the larger sense, is only a department of chemistry, that we have no right to consider such researches as not falling within the scope of our essay.

Papers on chemical mineralogy published by Prof. Brush are found in the *American Journal of Science*, viz.:—

Second series:—

Vol. x.	pp. 370.	Analyses of American Spodumine.
" xv.	pp. 207.	Re-examination of American Minerals. By J. Lawrence Smith and George J. Brush. Parts I.–III.
" xvi.	pp. 41.	
" xvi.	pp. 365.	

This joint work of Profs. Smith and Brush includes the examination of the following minerals:—

Part I. Emerylite, euphyllite, Litchfield mica, unionite, kerolite, bowenite, williamsite, lancasterite, hydromagnesite, magnesite.

Part II. Chesterlite, loxoclase, Danbury feldspars, Haddam albite, Greenwood mica, biotite, margarodite, Chesterlite talc, rhodophyllite, cummingtonite, hydrous anthophyllite, monrolite, ozarkite, dysyntribite, gibbsite, emerald nickel.

Part III. Danburite, carrollite, thalite, hudsonite, jenkinsite, lazulite, kyanite, elæolite, spodumene, petalite.

Vol. xviii.	pp. 407.	On the Chemical Composition of Clintonite (Seybertite).
" "	pp. 415.	On a New Test for Zirconia.
" xx.	pp. 273.	On Prosopite.
" xxiv.	pp. 128.	On the Chemical Composition of Antigorite.
" xxiv.	pp. 116.	On Dechenite and Eusynchite.
" xxiv.	pp. 124.	Note on Parathorite.
" xxv.	pp. 198.	Chemical Composition of Chalcodite.
" xxvi.	pp. 64.	Mineralogical Notices: Analyses of Gieseckite (?) from Diana, Compact Pyrophyllite, Unionite, Danbury Feldspar.
" xxvii.	pp. 395.	Chemical Examination of Boltonite.
" xxxii.	pp. 94.	On Crystalline Hydrate of Magnesia.
" xxxiv.	pp. 243.	On Amblygonite from Maine.
" "	pp. 402.	On Triphyline from Norwich, Mass.
" xxxvi.	pp. 122, 257.	On Childrenite from Hebron, Maine.
" "	pp. 152.	On the Tucson Meteoric Iron.
" xxxvii.	pp. 66.	On Tephroite.
" xxxix.	pp. 132.	On Artificial Diopside.
" xli.	pp. 246.	On Cookeite and Jefferisite.
" xliv.	pp. 219.	On Native Hydrates of Iron.
" xlvi.	pp. 140, 240.	On Sussexite.

Vol. xlviii. pp. 17. On Hortonolite.
" " pp. 17. On Durangite.
" " pp. 179. On a Meteoric Stone from Frankfort, Alabama.
" " pp. 360. On Magnetite in the Pennsville Mica.

Third series:—
Vol. I. pp. 28. On Galenite from New Jersey.
" II. pp. 30. On Ralstonite.
" V. pp. 421. On Compact Anglesite.

HENRY WURTZ, Hoboken, New Jersey.—Prof. Wurtz, who was at one time professor of chemistry in the Columbian Medical College at Washington, D. C., is now chemical editor of the Gas Light Journal in New York. His chemical contributions date from 1850, as follows. [Prof. Wurtz has furnished us the following notes on his papers.]—

1850. On a Supposed New Mineral Species. *Am. Journ. Sci.* [2], x. p. 80, July.

1850. On the Green Sand of New Jersey as a Source of Potash. Read to the American Association at New Haven, August, 1850. *Ibid.*, p. 326, November. [Analyses given of two raw green sand marls containing 6·38 per cent., and 4·94 per cent. of KO. The fact first announced that dilute sulphuric acid yields *alum* directly, readily crystallizing out from solution of the green sand granules. Previous ignition peroxidized the iron chiefly, and the alum then obtained was mostly free from iron. The fact was first announced that when the grains, even without pulverization, were fused at a low temperature with chloride of calcium, in sufficient proportion to form a pasty mass, complete double decomposition was effected, and the mass yielded to water, "all the potash which was contained in the green sand employed in the form of chloride of potassium." Upon this was founded "a method of decomposing minerals in the process of analysis," presented to the Association at the same meeting. Sulphate of potash was obtained by fusing together alum and chloride of potassium.]

1850. On a New Method of Decomposing Silicates in the Process of Analysis. Read to the American Association at New Haven, August, 1850. *Ibid.* [2], x. p. 323, November. [Feldspar and hornblende were found, when fused with chloride of calcium, to be completely fluxed, and decomposable by muriatic acid. It was suggested to use, at times, chloride of barium, instead of chloride of calcium, because of its freedom from deliquescence. A mixture, in equivalent proportions, of the chlorides of barium and strontium was found very advantageous, from its far greater fusibility. An analysis was given, made by this method, of the pink scapolite of Bolton, Massachusetts.]

1851. On Bromine as a Toxicological Agent. By Henry Wurtz, Assistant in the Yale Analytical Laboratory. *Ibid.* [2], xi. 405, May. [Bromine with water and heat was used to replace chlorine to destroy the organic matter of stomachs, etc., to isolate mineral poisons.]

1852. On the Preparation of Pure Hydrate and Carbonate of Potash. *New York Journ. Pharm.* February, 1852, i. 33. [Elimination of silica from solutions of potassic carbonate by evaporating with the addition of carbonate of ammonia in lumps. Superiority of flint-glass bottles for solutions of potassic hydrate, on account of their greater resistance to corrosion. Preparation of pure hydrate from pure potassic sulphate, by reduction to sulphide, and boiling with oxide of copper, manganese, or iron. Residual undecomposed sulphate removed by solution of baric hydrate.]

1852. Preparation of Chemically Pure Hydrate and Carbonate of Soda. *Ibid.*, i. 36. February, 1852. [Commercial bicarbonate of soda is freed from sulphate, phosphate, and chloride by washing with water by decantation, then dried on the sand-bath, and exposed to a heat below redness, to expel CO_2. On solution in water, the silica is chiefly left in flakes. Remaining traces of silica then removed by evaporation with addition of lumps of ammonic carbonate, and resolution. To obtain dry pure carbonate, the last solution is then re-evaporated in vessels of Pt, Ag, or clean Fe, avoiding glass and porcelain. To obtain pure sodic hydrates, the carbonate must be decomposed by lime, which is free from silica.]

1852. Preparation of Pure Barium Compounds (with other subjects). *Ibid.*, June, 1852, i. 161. [The important point is here the first announcement of the power of baric carbonate, either precipitated, or pulverized witherite, to precipitate gypsum totally from its solutions; with the first suggestion to utilize this property for purifying waters for steam purposes, sea-water included. Brine of salt works also mentioned as a proper subject.]

1852. Preparation of Pure Magnesia. *Ibid.* i. 199. [Commercial *magnesia alba* dissolved in nitric acid, and by digestion with an excess of the carbonate, all silica, ferric oxide, alumina, and PO_5 separated. To eliminate lime, some magnesic sulphate and alcohol added, the latter in quantity insufficient to cause immediate precipitation. In the course of time the lime crystallizes out as gypsum. The liquid is then evaporated and heated, with stirring and addition of powdered carbonate of ammonia, to expel the nitric acid. On ignition, and washing with distilled water after cooling—to remove sulphates and alkaline salts—chemically pure magnesia remains. Oxalate of lime was found to be appreciably soluble in magnesic solutions, and hence lime could not be eliminated as oxalate from such solutions.]

1852. On the Preparations of Iron used in Medicine. *Ibid.*, i. 229. [Preventing oxidation of ferrous compounds by introducing into the bottle fragments of quicklime wrapped in paper. Alcohol will not preserve ferrous salts, as generally supposed, as it absorbs oxygen from the air, and conveys it thereto. To obtain ferrous sulphate free from ferric salt, baric carbonate employed. Another new mode, by agitation with pulverized protosulphide of iron. To obtain pure ferric oxide, dissolve separately in hot water five of recrystallized copperas, six of crystallized sodic carbonate, and one of nitrate of soda, filter, mix, evaporate to dryness, and heat the mass to faint redness. Water then leaves undissolved a heavy impalpable, but perfectly soluble, ferric oxide. Coal gas is proposed to be used, instead of hydrogen, in making *pulvis ferri.*]

1853. Purification of Sal Ammoniac. *Ibid.*, ii. 1, January, 1853. [The yellowish portions of loaves of sal ammoniac were known to be ferriferous. The transparent colorless parts were found to be equally so, and the iron found to be present as FeCl. The yellow color is not due to iron. Neither sublimation nor crystallization eliminated the iron, though so asserted in the books. Brewer's process of purification here first published—with Cl and NH_3.]

1856. On the Composition of the Water of the Delaware River. By Henry Wurtz, New Jersey State Chemist. *Am. Journ. Sci.* [2], xxii. 124, November, 1856. [Includes also an analysis of the water of springs proceeding from the crystalline gneiss rocks at Trenton, New Jersey.]

1858. Action of Nitric Acid on the Metallic Chlorides. *Am. Journ. Sci.* [2], xxv. 39. May, 1858. [This extended research, which is continued in the same journal, vol. xxvi. page 81, covered the behavior of hot nitric acid upon the chlorides of K, Na, Li, NH_4, Mg, Ca, Sr, Ba, Al, Gl, Fe, Mn, Co, Ni, Zn, Cd, Cu, Cr, U, Hg, Pb, Ag, Au, Pt, Sn, As, Sb, Bi, Ce, La, Di, Th, Zr, Mo, and V. Many new and important facts were developed, too numerous to detail here.]

1858. Detection of Nitric Acid in Solution, with Observations on the Action of Ferric Salts upon Indigo and Metallic Gold, and on the Neutralization of the Colors of Metallic Solutions. *Ibid.*, xxvi. 49, April. Read to the American Association in Baltimore, in April, 1858. [Containing the first observations of the power of ferric solutions to dissolve metallic gold and platinum.]

1858. A Method of Separation of Magnesia from the Alkalies. Read to the American Association in Baltimore, April, 1858. *Ibid.*, xxvi. 83. [The bases, as chlorides, are converted into nitrates by evaporation with nitric acid, ignition, and washing with water.]

1858. Action of Nitric Acid in the Cold upon some Metallic Solutions, with new modes of obtaining pure Compounds of Barium, Strontium, and Cadmium. *Ibid.*, 188. Read to the American Association, at Baltimore, April, 1858. [BaCl and CdCl, in strong solution, gave instantly, and SrCl more slowly, crystalline precipitates of pure nitrates. HgCl was also instantly precipitated, but went down as such, and not as nitrate. KCl and NaCl gradually form nitrates in the cold.]

1858. Suggestions regarding Economical Applications of Glycerine. Read to the American Association at Baltimore, April, 1858. *Ibid.*, xxxi. 195. [Mixing with mustard and other condiments, confectionery, chocolate, chewing tobacco, filling gas meters, making copying ink, etc.]

1858. Preparation of Pure Sulphates, etc. By Henry Wurtz, Professor of Chemistry in the National Medical College, Washington, D. C. *Ibid.*, xxvi. 367. [Elimination of iron from cupric sulphate by conversion to ferric oxide by ebullition with a little plumbic deutoxide, or even with minium, and then adding baric carbonate. The same method is applied to a great number of other sulphates, including Epsom salt. Referring to former paper, in which the precipitation of gypsum by baric carbonate is brought out, it is further suggested that plumbic carbonate be used for this, the lead being recovered again.]

1858. Improvements in the Preparation of Hard Minerals for Analysis. Read to the American Association at Baltimore in 1858. *Ibid.* 190. [Proposed to crush always in a hard iron mortar, and then to remove the abraded iron with iodine-water, also with a neutral solution of ferric chloride. When earthy carbonates are present, remove them first by boiling with ammonic chloride or nitrate, then iodine. Pyrrhotine was found to be separable from pyrites, by dissolving in iodine-water, the pyrites being insoluble therein. Elutriation of minerals in the iron mortar *with alcohol* recommended.]

1858. Chemical Examinations connected with a Bullet which had been imbedded for more than forty years in a Human Lung. *Ibid.*, 192. [The bullet was found corroded and partly encrusted with plumbic chloride, and the liquid in the enveloping cyst also contained lead. The body of the lung and the muscle of the diaphragm were found to contain lead.]

1858. Action of Hot Muriatic Acid upon some Metallic Nitrates. *Proc. Am. Ass. Advt. Sci.* (Baltimore, 1858), 181.

1859. On the Occurrence of Cobalt and Nickel in Gaston County, North Carolina. *Am. Journ. Sci.*, xxvii. 24, April, 1858.

1859. Modes of Increasing the Heat of the Mouth Blowpipe, with some blowpipe manipulations. *Ibid.*, xxvii. 24. [Paraffine candles proposed. Blowpipe with tube filled with potassic hydrate. Powdered silica may be fused or semi-fused into transparent globules. Borax beads, so highly supersaturated with oxides as to become opaque on cooling, found to remain transparent, if plunged while hot into cold water, and colored reactions thus brought out. New facts and experiments on interference of colors in blowpipe beads. Decolorization of ferriferous glass by manganese, shown to be due, in part at least, to such neutralization of colors.]

1866. Sodium Amalgam. *Ibid.* [2], li. 216.

1866. On Grahamite. *Ibid.*, lii. 420.

1869. Atmospheric Air mixed with Gas. *Ibid.*, lviii. 40.

1870. Gas Well in New York. *Ibid.*, lix. 336.

1870. On Flame Temperatures. *Ibid.*, lix. 339.

Samuel W. Johnson, Professor of Theoretical and Agricultural Chemistry in Yale College, has made the following contributions to chemistry :—

Memoirs and Lectures.

On the Houghite of Prof. Shepard. *Am. Journ. Sci.*, xii. (1851), pp. 361–365.

Chemische Notizen: 1. Chromsaures Kali-ammoniak; 2. Chromsaures Natron. Leichte Bereitungsweise desselben; 3. Ueber Kartoffel-fuselöl, Vorkommen von Propylalkahol und Caprinsäure in demselben; 4. Verbindung von Amylalkohol mit Chlorcalcium. *Journ. für Prakt. Chemie*, lxii. (1854), pp. 261–264.

Ueber das zweifach schleimsaure amyloxyd. *Journ. für Prakt. Chemie*, lxiv. (1855), pp. 107–9.

Ueber die schleimsauren Salze der Alkalien. *Liebig's Annalen*, xciv. (1855), pp. 224–230.

Chemische Untersuchung verschiedener Pflanzenaschen, Bodenarten, und Gewässer. *Liebig's Annalen*, xcv. (1855), pp. 226–242, von Prof. O. Sendtner und S. W. Johnson.

Essay on the Physical Properties of Soils as affecting Fertility. *Trans. N. Y. State Ag. Soc.*, 1856, pp. 101–124.

Examination of two Sugars (Panoche and Pinite) from California. *Am. Journ. Sci.*, xxii. (1856), pp. 6–8.

Lecture on the Relations that exist between Science and Agriculture. *Trans. N. Y. State Ag. Soc.*, 1857, pp. 73–95.

Lectures on Agricultural Chemistry. *Report of Smithsonian Institution*, 1859, pp. 78.

On Some Points of Agricultural Science. *Am. Journ. Sci.*, xxvii. (1859), pp. 71–85.

Soil Analysis. Notice of the Agricultural Chemistry of the Geological Surveys of Kentucky and Arkansas. *Am. Journ. Sci.*, xxxii., 1861, pp. 20.

With joint authorship of O. D. Allen.

On the Equivalent and Spectrum of Cæsium. *Am. Journ. Sci.*, xxxv. (1863), pp. 7.

The Assimilation of Complex Nitrogenous Bodies by Vegetation. *Am. Journ. Sci.*, xli. (1866), pp. 4.

With joint authorship of John M. Blake.

On Kaolinite and Pholerite. *Am. Journ. Sci.*, xliii. (1867), pp. 13.

Sources and Supply of Nitrogen to Crops. *Lecture to Conn. Board of Agriculture*, 1867, pp. 25.

On Native Crystallized Terpin. *Am. Journ. Sci.*, xliii. (1867), pp. 2.

On the Estimation of Carbonic Acid, and on Construction of Bunsen's Air-pump. *Am. Journ. Sci.*, xlviii. (1869), pp. 111–114.

On Nitrification. *Am. Journ. Sci.*, xlvii. (1869), pp. 234–242.

Soil Exhaustion and Rotation of Crops. Two Lectures. *Report of the Conn. State Board of Agriculture*, 1871, pp. 47.

On the Estimation of Nitrogen. *Am. Chemist*, iii. (1872), pp. 161–2.

On the Use of Potassium Dichromate in Ultimate Organic Analysis. *Am. Journ. Sci.* [3], vii. (1874), pp. 465–8.

Reports.

Reports to the Connecticut State Agricultural Society, Hartford, Ct.

For 1857. General Considerations on Manures; Examination of forty-three fertilizers, pp. 58.

For 1858. Essay on the Nature and Agricultural Uses of Peat and Swamp Muck, and Analyses of thirty-two samples; Examination of twelve fertilizers, pp. 174.

For 1859. Examinations of twenty fertilizers, pp. 67.

Reports to the Connecticut State Board of Agriculture.

For 1868. Examinations of sixteen fertilizers, pp. 18.

For 1869. Valuation of Commercial Fertilizers, pp. 18.

For 1872. Composition of the Ash of Connecticut Tobacco leaf, etc., pp. 40.

For 1873. Analyses of thirty-one Commercial Fertilizers, pp. 21.

Systematic Treatises.

Peat and its uses as a Fertilizer and Fuel. N. Y., O. Judd & Co., 1866, pp. 168, 12mo.

How Crops Grow. N. Y., 1868, pp. 394.

The same, edited by Church and Dyer, London, 1869.

The same in German, translation by Baron H. v. Liebig. Braunschweig, 1871.

The same in Russian, translation by N. R. Temashev. St. Petersburg, 1873.

How Crops Feed. N. Y., 1870, pp. 375.

The same in German, translation by Baron H. v. Liebig. Braunschweig, 1872.

Any notice of Prof. Johnson's contributions to chemistry would be extremely deficient, should it fail to mention his well-known edition of Fresenius' Manual of Qualitative and Quantitative Analysis, in two volumes, 1869–1870. A new edition of this work by Prof. Johnson is now in preparation.

John Leconte, Oakland, California. — Dr. Leconte's contributions to science are all from the physical side, and how important they are is too well known to require comment. He is now the Professor of Physics and Mechanics in the University of California. The following physico-chemical papers by Dr. Leconte fall properly within our scope.

1. "Observations on a Remarkable Exudation of Ice from the Stems of Vegetables, and on a Singular Protrusion of Icy Columns from Certain Kinds of Earth during Frosty Weather." *Proceedings of American Association for Adv. of Sci.*, 3d Meeting, at Charleston, S. C., March, 1850, pp. 20–34.—*Lond., Edin., Dub., Phil. Mag.*, 3d S., vol. xxxvi. pp. 329–342, May, 1850.

2. "Observations on the Freezing of Vegetables, and on the Causes which enable some Plants to endure the action of Extreme Cold." *Proceedings of Am. Assoc. for Adv. of Sci.*, 6th Meeting, at Albany, N. Y., August, 1851, pp. 338–359.—*Am. Journ. of Sci. and Arts.* 2d S. vol. xiii. pp. 84–92 and 196–206, Jan. and March, 1852.

3. "Preliminary Researches on the alleged Influence of Solar Light on the Process of Combustion." *Proceedings of Am. Assoc. for Adv. of Sci.*, 11th Meeting, at Montreal, C. E., Aug. 1857, Part I., pp. 93–109.—*Am. Journ. Sci. and Arts*, 2d S. vol. xxiv. pp. 317–330, Nov. 1857. Also, *Lond., Edin., Dub., Phil. Mag.*, 4th S. vol. xvi. pp. 182–197, Sept. 1858.

4. "On the Influence of Musical Sounds on the Flame of a Jet of Coal-Gas." *Am. Journ. Sci. and Arts*, 2d S. vol. xxv. pp. 62–65, Jan. 1858. Also, *Lond., Edin., Dub., Phil. Mag.* 4th S. vol. xv. pp. 235–239, March, 1858.

5. "On the Adequacy of Laplace's Explanation to Account for the Discrepancy between the Computed and the Observed Velocity of Sound in Air and Gases." —*Lond., Edin., Dub., Phil. Mag.*, 4th S. vol. xxvii. pp. 1–33, Jan. 1864. The latter part of No. 5 touches upon the question whether the atmosphere is a *Mechanical Mixture* or a Chemical Compound.

James Schiel, Ph.D., St. Louis, Mo.—Dr. Schiel's chemical contributions in the *American Journal of Science* are—

1853. On the Separation of Manganese from Iron and Nickel [2], xv. 275.

1855. On the identity of Sanguinarine and Chelerithene, and on the direct determination of Nitrogen [2], xx. 220–222. Compare *Ann. de Chem. und Pharm.*, Liebig and Wöhler, B. xliii. 233.

[See entry under Dr. James F. Dana.]

1860. On the Products of the Distillation of Common Rosin [2], xxx. 100–102.

Dr. Schiel is also the author of a systematic treatise on Analysis, entitled "*Anleitung zur Organischen und Gasanalyse*," Erlangen, 1860. 8vo. pp. 200.

Charles A. Joy, Ph.D., Professor of Chemistry, Columbia College, New York. Professor Joy has published—

1852. Analyse des Narwall-zahns und des Gehaüses von Helix Pomatia. *Ann. der Ch. und Pharm.*, lxxxii., Bd. 3, Heft 365.

1853. Uber das Selenäthyl. *Ibid.*, lxxxii. 35.

1853. Analyse des Meteoreisens von Cosbys Creek. *Ibid.*, 39.

The chemical papers by Dr. Joy, published in the *Am. Journ. of Sci.*, are as follows:—

1863. On Glucinum and its Compounds. [2], xxxvi. 83–91.

1864. Analysis of a Meteorite from Chili. *Ibid.*, xxxvii. 243–248.

Prof. Joy has been a constant contributor to the current literature of science in various publications not available for our present purpose.

Besides the papers enumerated, Prof. Joy has contributed to Dana's Mineralogy the chemical analyses of several minerals. The research on selenäthyl cited above, is among the earliest contributions to a class of alcohol radicals combined with a metallic base which appeared in chemical literature.

Charles A. Goessmann, Ph.D., of Amherst, is now the chemist of the Massachusetts Agricultural College located at Amherst. During his residence at the salines of Syracuse Dr. Goessmann made himself well known by his able discussion of the chemistry of brines. But Dr. G.'s contributions to chemistry cover a wide range, and prior to his coming to this country he was a frequent contributor (1854–58) to the *Annalen von Wöhler, Liebig, and Kopp*, as will be seen by the following list of chemical papers:—

In 1854. *Annalen der Chemie u. Pharmacie, von Wöhler, Liebig, u. Kopp*

On Palmitic Acid	Bd. 89—H. 123
On Arachidic Acid—a new fatty acid	89—1—11
On the Composition of the Cocoa-Oil	90—126
On Benzoglycolic Acid from Hippuric Acid	90—181
On a New Mode of Procuring Ethylamin	90—122
On the Constitution, etc., of Leucine	91—129
In 1856. A New Mode of Procuring Amarine u. Lophine	93—329
On Hypogaeic Acid—a new acid in Peanut Oil	94—230
In 1856. On the Combinations of Arachidic Acid	97—257
On the Constitution of the Lophine	97—283
On the Separation of Coumarin	98— 86
On the Separation of Styracin	
On Certain Products from Hypogaeic Acid, Gaidic Acid, etc. (This paper was published by C. A. G. and G. C. Caldwell, of Cornell University)	99—305
On Manganate of Potassium as a Suitable Substance to Decolorize Uric Acid, Hippuric Acid, etc.	99—373
On a New Mode of Procuring Triphenylamine	100— 57
On the Action of Zinc Chloride on Hippuric Acid	100— 69
On the Crystallization of Sulphocyanide of Silver	100— 76
In 1857. On the Action of Iodide of Ethyl on Tungstate of Silver	101—218
On a New Mode of Producing Tricapronylamine	101— 31
On the Transformation of Nitrobenzol into Aniline by Means of Arsenious Acid and Caustic Potassa	102—127
On a New Sugar Plant, Sorghum Saccharatum	104—335

In 1858. Contribution to the Knowledge of the Nature of the Chinese Sugar-cane, Sorghum Saccharatum; see Transactions of the New York State Agricultural Society of 1861, 785.

In 1862. Report on the Chemical Composition of the Brines of Onondaga, New York; Syracuse, December, 1862.

In 1862–63. Report on the Brines of Michigan (see Senate Report, New York, 1862—63, House Documents); also, House Committee of the Legislature of Michigan, No. 37, 1865.

In 1863. Report on the Best Mode of Manufacturing Coarse or Solar Salt from the Brines of Onondaga. Syracuse: December, 1863.

In 1864. Contribution to the Manufacture and Refining of Sugar; or the Application of Caustic Magnesia for Sugar Refining. Syracuse. Reprinted, *Chemical News*, London, etc., 1864–65.

In 1865. Notes and Criticism on the Manufacture of Sugar upon the Island of Cuba. Syracuse. Reprinted, *Chemical News*, London, etc., 1865.

In 1866. Contribution to the Chemistry of the Mineral Springs of Onondaga. Syracuse: February, 1866. Also *Amer. Journ. of Sci.*, September and October, 1866.

In 1867. Report on the Salt Deposit of Petite Anse, Louisiana. Published by the American Bureau of Mines. New York: January, 1867.

Contribution to the Chemistry of Brines. *Amer. Journ. of Sci.*, July and November, 1867.

In 1868. Report on the Salt Resources of Goderich, Canada. Syracuse.

In 1869. On the Chemistry of Common Salt with Reference to our Home Resources. Read before the National Academy at the Northampton Meeting; see *Amer. Journ. of Sci.*, January, 1870.

On Salt and its Uses in Agriculture; see Report of Massachusetts State Board of Agriculture. Boston, 1870.

In 1870. On the Cultivation of the Sugar Beet-Root as an Agricultural Enterprise. College Report of the Trustees of the Massachusetts Agricultural College. December, 1870; see also *Amer. Chem.*, 1871.

On Cheese as Food; see Report of American Dairymen's Association. Utica, New York. January, 1870.

In 1871. Report on the Chemical Composition of some Dairy Products; see Annual Report of the Massachusetts State Board of Agriculture, 1871–72, pp. 305.

In 1872. On the Stassfurt Potash Compounds, and their Present Reputation in the Agricultural Industry of Europe; see *Amer. Chem.*, 1872, July.

Report on the Quality of Sugar Beet-Roots raised upon the Farm of the Massachusetts Agricultural College, with regard to their Fitness for Sugar Manufacture; see *Amer. Chem.*, 1872.

Contribution to the History of the Beet Sugar Manufacture within the United States; see *Amer. Chem.*, 1872, July.

Contributions to the Requirements for a Successful Home Beet Sugar Industry; see *Amer. Chem.*, 1872, August and November.

In 1873. On the Fertilization of our Farm Lands with Reference to the Judicious Application of Mineral Fertilizers; see Journal of New York State Agricultural Society of January and February, 1873.

In 1873. Report on Commercial Fertilizers, and their Importance in our Present Condition of Agricultural Industry; see Tenth Annual College Report of the Massachusetts Agricultural College, 1873.

On Nitrogen and the Extent of its Natural Resources for Agricultural Purposes; see Report of Massachusetts State Board of Agriculture of 1873–74.

In 1874. Results of Experiments with the Cultivation of the Sugar Beet-Roots throughout the State of New York, Eastern Canada, and upon the College Farm during the year 1873; see College Report for 1873–74.

Report on the Present Condition of our Resources of Commercial Concentrated Fertilizers; see First Official Report of the State Inspector, C. A. G., Amherst, Mass., July 8, 1874.

Eugene W. Hilgard, Ann Arbor, Mich.—Prof. Hilgard, long of the University of Mississippi, and attached to the Geological Survey of that State, is now the Professor of Chemistry at the University of Michigan.

His chemical papers are as follows:—

1. Beitrag zur Kenntniss der Lichtflamme (Inaug. Diss.). *Ann. Chemie und Pharm.*, vol. xcii. p. 129, 1854. (Fifteen analyses of the gases from the "dark cone" of the tallow and wax flames; demonstrating the presence of N and H in the lowest parts of the flame, the absence of free O, and *the combustion of C prior to H*, contrary to the statement in most text-books.)

2. On the Quantitative Assay of Chromium by blowpipe processes. In *Proc. A. A. Sc.*, 1857; abstract *Am. Journ. Sci.*, 1857.

3. On the Condition of our Knowledge of the Chemical Processes in Luminous Hydrocarbon Flames. *Proc. Am. A. Sc.*, 1868.

4. On the Geology of the Delta, and the Mudlumps of the Passes of the Mississippi. *Am. Journ. Sci.*, vol. I., 1871, with analyses of the waters and gases, and a discussion.)

5. On Soil Analyses and their Utility. *Am. Journ. Sci.*, Dec, 1872.

6. On the Silt Analysis of Soils and Clays. *Am. Journ. Sci.*, Oct. and Nov. 1873.

7. Silt Analyses of Mississippi Soils and Sub-soils. *Am. Journ. Sci.*, Jan. 1874.

Analyses of soils and rocks published in various Geological Reports.

John M. Maisch, Philadelphia, Pennsylvania.—Mr. Maisch has been editor of the *American Journal of Pharmacy* since the death of Mr. Procter, whose labors have been before mentioned. His chemical researches have been chiefly in pharmaceutical chemistry, and have been published in the *American Journal of Pharmacy* and in *Proceedings of the American Pharmaceutical Association*, as follows:—

Proximate Analysis.

Notes on the Alkaloids of Menispermum Canadense. *Am. Journ. Pharm.*, 1863, p. 301.

Berberina in Podophyllum Peltatum. *Ibid.*, 1863, p. 303.

On Resin of Podophyllum, Solubility in Boiling Water. *Ibid.*, 1874, p. 231.

Absence of Alkaloids in the Dead Stalks of Veratrum Viride. *Ibid.*, 1864, p. 98.

Alkaloid in Solanum Pseudo-Capsicum. *Ibid.*, 1864, p. 99.

Active Principle of Rhus Toxicodendron (Toxicodendric Acid). *Proc. Am. Pharm. Assn.*, 1865, p. 166.

Balsams of Liquidambar styraciflua and Orientale. *Am. Journ. Pharm.*, 1874, p. 163.

Chinese Blistering Bugs (Amount of Cantharidin in). *Proc. Am. Pharm. Assn.*, 1872, p. 246.

Chemical Examination of Coca Leaves. *Am. Journ. Pharm.*, 1861, p. 496.

Adulteration Notes, Assays, etc.

Carbonate of Lime substituted by Sulphate of Lime. *Am. Journ. Pharm.*, 1854, p. 210.

Examination of Bitartrate of Potassa. *Ibid.*, 1855, p. 204.

A New Falsification (Nitrobenzole) of Oil of Bitter Almonds. *Ibid.*, 1857, p. 544.

Examination of Adulterated Oil of Peppermint. *Ibid.*, 1860, p. 105.

Analysis of Commercial Glacial Phosphoric Acid. *Ibid.*, 1860, p. 193.

On the Detection of Croton Oil in Mixtures. *Ibid.*, 1860, p. 306.

Assay of Milk. *Ibid.*, 1860, p. 431.

Adulteration of Carmine. *Ibid.*, 1861, p. 17.

Assay of Commercial Iron by Hydrogen. *Ibid.*, 1861, p. 20.

Tests for the Purity of Glycerin. *Ibid.*, 1867, p. 117.

Note on Cheap Glycerin. *Ibid.*, 1867, p. 309.

Detection of Turmeric in Powdered Rhubarb and Mustard. *Ibid.*, 1871, p. 259.

On Volatile Oils (Detection of Adulterations). *Proc. Am. Pharm. Assn.*, 1858, p. 344.

Behavior of Essential Oils to Iodine and Bromine. *Ibid.*, 1859, p. 338.

Occasional Occurrence of Arsenic in American Sulphuric Acid. *Ibid.*, 1863, p. 255.

Assay of French Brandy and Whiskey. *Ibid.*, 1864, p. 291, and 1866, p. 267.

Quality and Assay of Sherry Wine. *Ibid.*, 1863, p. 296, and 1866, p. 269.

Analysis of a Chalybeate Water from Sharon Spring, New York. *Am. Journ. Pharm.*, 1861, p. 105.

Inorganic Chemistry.

Effects of Sunlight upon Solution of Ferrous Iodide. *Am. Journ. Pharm.*, 1854, p. 408, and 1855, p. 218.

Solubility of Iodides in Syrup of Ferrous Iodide. *Ibid.*, 1857, p. 210.

Protiodide of Mercury (Processes for obtaining it). *Ibid.*, 1857, p. 11.

Alumen Exsiccatum (Heat required for preparing it). *Ibid.*, 1860, p. 16.

Crystalline Forms of the Chlorides of Potassium and Ammonium. *Ibid.*, 1860, p. 521.

Conversion of Monohydrated into Common Phosphoric Acid. *Ibid.*, 1861, p. 385.

Pyrophosphate of Soda and Iron. *Ibid.*, 1867, p. 388.

Hydrobromic Acid (Preparation of). *Proc. Am. Pharm. Assn.*, 1860, p. 220.

Organic Chemistry.

On the Strength of Diluted Acetic Acid. *Am. Journ. Pharm.*, 1858, p. 306.

Notes on Benzoic Acid and some Benzoates. *Ibid.*, 1860, p. 204.

Specific Gravity of Aqueous Solutions of Tartaric Acid. *Proc. Am. Pharm. Assn.*, 1863, p. 204.

Acid Reaction of Chloral Hydrate. *Ibid.*, 1873, p. 621.

Chloride of Mercurethyl (Review of Literature). *Am. Journ. Pharm.*, 1873, p. 9.

Citrate of Ammonia a Solvent for Phosphate of Iron. *Ibid.*, 1859, p. 410.

Solution of Citrate of Magnesia. *Ibid.*, 1867, p. 1.

Solution of Acetate of Iron. *Ibid.*, 1867, p. 7.

Preparation of Heavy Oil of Wine. *Ibid.*, 1865, p. 100.

Decomposition of Pure Chloroform. *Proc. Am. Pharm. Assn.*, 1866, p. 264, and *Am. Journ. Pharm.*, 1868, p. 289.

On Amylo-Nitrous Ether (Preparation of Nitrate of Amyl). *Am. Journ. Pharm.*, 1871, p. 146.

Monobromated Camphor (New Process, Properties, Analysis). *Ibid.*, 1872, p. 337.

On Colchicia. *Ibid.*, 1867, p. 97.

Decomposition of Acetate of Morphia in Aqueous Solutions. *Ibid.*, 1871, p. 49.

Precipitation of Morphia Salts by Alkaline Cyanides. *Ibid.*, 1871, p. 258.

Decomposition of Sulphate of Quinia by Acetates. *Ibid.*, 1855, p. 97, and 1858, p. 385.

Precipitation of Quinia by Iodide of Potassium from Acid Solutions. *Ibid.*, 1871, p. 51.

Solubility of Glue in Glycerin. *Ibid.*, 1870, p. 515.

Theo. G. Wormley, M. D., Professor of Chemistry and Toxicology at Starling Medical College, Columbus, Ohio, is widely known to chemists by his beautiful work, "The Micro-Chemistry of Poisons," which, as an original contribution to the special department of chemistry which it covers, has no equal in any language. This work is unrivalled in its exquisite plates, drawn and engraved by the graceful hand of Mrs. Wormley. Besides this standard work, Dr. Wormley has contributed the following original papers:—

"Systematic Quantitative Analysis of Urine," *Ohio Med. and Surg. Journ.*, vol. vii. July, 1855.

"Chemical Reactions of Strychnine," *Amer. Journ. Sci. and Arts*, 2d series, xxviii. Sept. 1859.

"Chemical Reactions of Atropine," *Chemical News* (London), vol. ii. June, 1860.

"Chemical Reactions of Brucine," *Ibid.*, ii. July, 1860.

"Chemical Reactions of Morphia," *Ibid.*, ii. Sept. 1860.

"Chemical Reactions of Narcotine and Meconic Acid," *Ibid.*, ii. Sept. 1860.

"Chemical Reactions of Corrosive Sublimate," *Ibid.*, ii. No. 43.

"Chemical Reactions of Veratrine," *Ohio Med. and Surg. Journ.*, xii. No. 6, 1860.

"Chemical Reactions of Nicotine and Daturine," *Ibid.*, vol. xiii. No. 1.

"Chemical Reactions of Solanine," *Ibid.*, vol. xiii. No. 2.

"Chemical Reactions of Codeine, Meconine, Narceine, and of Aconitine." *Ibid.*, xiii. No. 4, 1861.

"Chemical Reactions of Conine," *Ibid.*, xiv. No. 1, 1862.

"Chemical Reactions of Oxalic Acid," *Ibid.*, xiv. No. 5.

"Contribution to our Knowledge of the Chemical Composition of Gelseminum Sempervirens," *Amer. Journ. Pharmacy*, 3d series, xviii. No. 1, 1870.

The last-named paper contains an account of the mode of preparation and the chemical and physiological properties of a new alkaloid (gelseminine), and of a new organic acid (gelseminic acid).

"Methods of Analysis of Coals, Iron Ores, Furnace Slags, Fire Clays, Limestones, and of Soils," *Report of Progress of Geological Survey of Ohio for* 1870.

Dr. John C. Draper, of the College of the City of New York, has made the following contributions:—

1. "Origin of Urea in the Body," *N. Y. Journ. of Med.*, Feb. 1856.
2. "Products of Respiration," *N. Y. Med. Times*, July, 1856.
3. "Determination of the Diurnal Amount of Sunshine by the Precipitation of Gold," *Lond. Phil. Mag.*, Aug. 1859.
4. "Insensible Perspiration," *Proceedings of N. Y. Academy of Medicine*, 1864.
5. "Adulterations in Coffee," *Lond. Phil. Mag.*, Aug. 1867.
6. "Improvement in Filtration," *Ibid.*, May, 1870.
7. "New Light Unit," *Scientific American*, Oct. 21, 1871.
8. "Causes of Decay in Brick and Stone," *Ibid.*, Nov. 25 and Dec. 2, 1871.
9. "New Process for the Quantitative Determination of Arsenic," *American Chemist*, June, 1872.
10. "Growth of Seedling Plants," *Amer. Journ. of Science and Arts*, Nov. 1872.
11. "Influence of Cold on the Temperature of the Body," *Ibid.*, Dec. 1872.

THE AMERICAN CHEMIST.

VOL. V. NO. 6.

AN ESSAY ON AMERICAN CONTRIBUTIONS TO CHEMISTRY.*

Read before the Centennial Celebration at Northumberland.

BY PROF. BENJAMIN SILLIMAN,

of New Haven, Conn.

Continued from p. 114.

JAMES SCHIEL, St. Louis, Mo.—In addition to the titles given on page 111, we note as follows:—

On the Classification of Organic Substances by series, *Am. Journ. Sci.* [2], xxxii. 48, 1861. This author had previously, as early as 1842, enunciated already the principle of progressive series, afterwards adopted by Gerhardt, unchanged, save only in name, under the title of Chemical Homology. Dr. Schiel's original paper was entitled—

"Bemerkungen über die Organischen Radikale," *Liebig & Wöhler's Annalen der Ch., etc.*, xliii. 107. July, 1842.

Dr. Schiel's paper, in 1861, is certainly one of the most important contributions made in America to chemical theory.

Einleitung in das Studium der Organischen Chemie. Erlangen, 1860, 8vo. This excellent treatise followed close upon the author's work on Organic and Gas Analysis, noticed on page 111. It contains a chapter on the classification of organic bodies by series, which fully sets forth the author's original views on this subject.

"On the Presence of Phosphoric Acid in Igneous Rocks." *Am. Journ. Sci.* [2], xxxi. 383, 1861.

The following additional titles of papers by Dr. Schiel are found in *Liebig und Kopp's Annalen, etc.*, Ueber die Angebliche Eigenschaft der Galle, den Zucker in Fett überzuführen, lviii. 96, 1846.

Beiträge zur Kenntniss des Krapps, lx. 74, 1846.

Annalyse der Krappsamenasche, lxix. 143.

ALEX. MEANS, LL.D., Prof. Natural Philosophy, Emory College, Oxford, Ga.—Dr. Means has published the following essays and contributions falling within our plan:—

1. A treatise upon "Electro-physiology," published by request of the Class of the Medical College of the State of Georgia, in the year 1840, in which institution the author was for nineteen years Professor of Chemistry and Pharmacy. It was subsequently republished in the *Medical and Surgical Journal*, issued by that college.

2. An article upon "The Dichloride of Mercury (Calomel)," published afterwards in the same Journal, for March, 1845.

3. An essay on "Alcohol—its *History, Pharmaceutical Origin* and *Uses, Chemical Constitution, Medical Claims* and '*Modus operandi;*' together with the *Physiological* and *Pathological Phenomena* consequent upon its administration, and the *Antidotal Treatment* required." Published in the *Augusta Med. and Surg. Journal*, Feb. 1847.

4. An article entitled "The Philosophical Construction of Chemicals," adapted to practical use, and the chemical laws involved explained and illustrated by appropriate diagrams. Published in the *Educational Repository and Family Monthly*, the organ of the "Educational Institute of the Methodist Episcopal Church South," July, 1860.

5. An essay on "Electricity," embracing its history as a science, and its phenomenal manifestation in the organic and inorganic kingdoms of nature. Published serially in *Scott's Monthly Magazine*, Atlanta, Ga., in 1867.

6. An article on "The Poison of Venomous Reptiles." Published in the *Medical and Surgical Journal* of Augusta, Ga., Jan. 1846.

7. Analysis of the Atlanta Mineral Springs, and of the Warm Springs of Merewether County, Ga. Carbonated chalybeate waters; together with the Cold Spring. Acidulo-carbonated chalybeate waters in the same locality. These were published by Mr. George White, formerly of Savannah, in his volume entitled "Statistics of the State of Georgia," in 1849.

Dr. Means has invented several new forms of apparatus for chemical and physical illustration, for which he has received premiums of silver plate. These pieces of apparatus are all to be found in the catalogue of Mr. E. S. Retchie, 1855.

P. D. KEYSER, M.D., Philadelphia, Pa.—Dr. Keyser, while a student in Dr. F. A. Genth's laboratory, published the following analyses, which are all to be found in the fifth edition of Dana's Mineralogy.

1853. Owenite from Harper's Ferry. *Am. Journ. Sci.* [2], xvi. 168.

1854. Thalite of Owen. *Ibid.* [2], xvii. 131.

1855. Allanite from Reading and Bethlehem, Pa., and from Orange County, N. Y. *Ibid.* [2], xix. 20.

1857. Barnhardite, a new mineral. *Ibid.*, 17.

JOSIAH P. COOKE, Jr., of Harvard University, has been an assiduous and successful laborer, both in the field of authorship, teaching, and research, alike in pure chemistry, molecular physics, and theoretical chemistry. His "Chemical Physics," published in 1860, is an elaborate treatise, in advance of anything before attempted in this country, or in fact in our language; and in his "First Principles of Chemical Philosophy" (1868), we have the matured development of an earlier book, "Chemical Problems and Reactions" (1857). These works mark an important advance in the methods of chemical instruction in this country. In the Chemical Philosophy the subject is developed according to the modern theories of the science. In Part First the fundamental principles of the science are discussed, and in the Second Part a brief summary of the more important elements and compounds is given, illustrated and enforced by means of familiar reactions and problems. As is well known, Prof. Cooke had been largely instrumental in changing the older didactic methods of chemical instruction formerly in use, rendering them more

* *Errata.*—On p. 38, 1st column, 10th line from bottom, *for* Prof. A. W. Wright, University of Cincinnati, *read* Yale College, New Haven.
On p. 73, left-hand column, 11th line from bottom, *for* D. Wolcott Gibbs, *read* O. Wolcott Gibbs.
On p. 77, right-hand column, 29th line from top, *for* Vaquelin, *read* Vauquelin.
On p. 80, left-hand column, 27th line from bottom, *for* Sybert, *read* Seybert.
On p. 85, right-hand column, 6th line from bottom, *for* Brougniart, *read* Brogniart.
On p. 86, left-hand column, 2d line from top, for Brougniart, *read* Brogniart.
On p. 104, right-hand column, 5th line from bottom, *for* Gysolite, *read* Gyrolite.
On p. 105, left-hand column, 20th line from bottom, for New Precipitation, *read* Non-precipitation.
On p. 110, 2d column, 17th line from top, and in each of the five lines following, the references li., lii, lviii., lix. should be xli, xlii., xlviii, xlix. There is no volume beyond l. The third series commences again vol. i., etc.

exact and searching by a free use of the blackboard in the recitation room and laboratory.

In 1854, Prof. Cooke communicated to the American Academy, at Boston, a memoir on "The numerical relation between the atomic weights, with some thoughts on the classification of the chemical elements." This paper is also found in the *American Jour. of Science* ([2], xvii. pp. 387–407), accompanied by a table of the "Isomorphs," "Homologues," and "Atomic weights" of the several series, or groups of elements, with their "affiliations." This memoir received the highest encomiums of Sir John Herschel in his remarks on chemical science, at the Leeds meeting of the British Association for Advancement of Science, in 1858. Its principles are embodied in the author's Chemical Philosophy.

In 1855, Prof. Cooke published a memoir "On an apparent Perturbation of the Law of Definite Proportions observed in the compounds of Zinc and Antimony" and this paper was in September, 1860, followed by a second on the same subject entitled "Crystalline Form not necessarily an indication of Definite Chemical Composition; or on the possible variation of constitution in a mineral species independent of the phenomena of isomorphism." These papers are both founded on the careful study of the compounds of zinc and antimony, the nature of which was first set forth by the same author in his memoir "On Stibiotrizincite and Stibiobizincite, two new compounds of Zinc and Antimony, with some remarks on the decomposition of water by the alloys of these metals" (*American Journ. of Science*, [2] xvii., pp. 229–237); this whole research is a fine model of a chemical investigation. It is noteworthy that two of the gentlemen who were at the time of these investigations students in Prof. Cooke's laboratory, and whose work in this investigation the author gratefully recognizes, are Messrs. Eliot and Storer, names since, and now, so honorably associated in higher, and the highest duties, in Harvard University, and in joint authorship of books on our science of wide use in our best colleges and schools.

Another paper on theoretical chemistry by Prof. Cooke is that "On Atomic Ratio in Mineral Formulæ," published in 1869 (*Am. Journ. of Sci.*, [2] xlvii. pp. 386–390.)

"Chemistry and Religion" is the title of a series of Sunday evening lectures, delivered upon the Graham foundation in Brooklyn in 1861. It is an American Bridgewater Treatise, and considers in an able and attractive manner the proofs of God's plan in the atmosphere and its elements (8vo. pp. 348, N. Y., Chas. Scribner, 1864).

Prof. Cooke's paper "On Danalite, a new mineral species from the Granite of Rockport, Mass." (*Am. Jour. Sci.* [2], xlii. 73, 1866), is a fine example of chemical research, and of the value of accurate observation for the discovery of new and interesting facts in old fields supposed to have been long since gleaned.

Prof. Cooke has lately published "The New Chemistry," a volume of 326 pages in *The International Scientific Series*, which is a lucid and logical discussion of the principles of chemical philosophy in a series of thirteen lectures, which were delivered before the Lowell Institute in Boston, in the autumn of 1872. Of this volume it is remarked by the *Am. Journ. of Sci.* (April, 1874), "Prof. Cooke's style is always attractive for its clearness, precision, and polish, and any cultivated person, whether previously acquainted with chemistry or not, can read this discussion of chemical philosophy with both pleasure and profit. It is needless to add that the subject is discussed, as its title demands, in the terms of the new chemistry."

Of special researches in mineralogical and general chemistry, Prof. Cooke has published many valuable papers, chiefly in the *American Journal of Science*, and in the *Proceedings of the American Academy*, at Boston, special mention of which it is needless to make at this time. His last memoir, "On the Vermiculites," is certainly one of the most important contributions to mineralogical chemistry which has been made by any chemist, at home or abroad, in some years, whether we regard it from its chemical, physical, or mineralogical aspects. It forms part of the ninth volume of the *Proceedings of the American Academy of Arts*, etc., at Boston, and a full abstract of it will be found in the seventh volume of the 3d series of *Am. Journ. of Sci.*, pp. 420–437.

Prof. Cooke has also made many and important contributions to the apparatus for chemical and physical demonstration and research, with the cunning hand of a skilful experimentalist and manipulator.

Under the voluntary or elective system now in vogue at Harvard, and of which Prof. Cooke has been an earnest and successful advocate, that University has now the largest number of under-graduates devoted to chemical studies in their well-appointed chemical laboratories which have been assembled at any academical institution in this country.

John Addison Porter.—The late Prof. Porter, who died in 1866, was a graduate of Yale College in 1842, studied chemistry with Liebig at Giessen after a brief term of service as Professor of Rhetoric and Reub Languages in Newark College, Delaware; was appointed to the chair of Technical Chemistry at Breren University, when in 1853 he was transferred to the chair of Agricultural Chemistry, and then of Organic Chemistry, in the Scientific School at Yale College, afterwards to the Sheffield Scientific School. Prof. Porter was distinguished for his scholarly accomplishments. His published papers in Chemistry are—

1849. "Unterschung der Asche Menschlicher Excremente." *Ann. d. Ch. u. Pharm.*, lxxi. 109.

1849. "Ueber ein Product der Einwirkung der Salpeter säure auf Holzfaser." *Ibid.*, 115.

1850. "Aschenanalyse vol Hafer, Herr und dern Rückstand von der Destillation des Kartoffelbranntweins." *Ibid.*, lxxvi. 382.

1849. "Ash Analysis: Potato refuse; Oats; Hay." *Amer. Journ. Sci.* [2], ix. 20.

1849. "A Product of the Action of Nitric Acid on Woody Fibre." *Ibid.*, 20.

Prof. Porter was the author of a Chemical Textbook for Schools, which has passed through many editions. A notice of his life will be found in the *Amer. Journ. Sci.* [2], xlii. 290, 1866.

Newton Spalding Mauross, Ph.D.—The late Prof. Mauross, who fell while gallantly leading a charge at the head of his company in the sixteenth Connecticut Volunteers at the battle of Antietam, September 17, 1862, was then acting Professor of Chemistry at Amherst, Mass. Dr. Mauross was a graduate at Yale College in 1849, and took the Degree of Doctor of Philosophy, at Göttingen, in 1852. Dr. Mauross published:—

1852. "Artificial Formation of Minerals," an inaugural dissertation at Göttingen. The mineral species found and described, with analyses, were Heavy Spar;

Celestine; Archydrite; Apatite; Pyromerphite; Wolfram; Tungsten; Scheeletine; Wolfenite; Crocoirite; and Anglesite. *Amer. Journ. Sci.* [2], xvi. 186, and *Ann. d. Chem. u. Pharm.*, lxxxii. 348.

"Ueber die Künstlicher Darsteltung von Krystaltisirtem Wolframsaurem Kalk." *Ann. d. Chem. u. Pharm.*, lxxxi. 243.

1855. Dr. Mauross also published an interesting "Notice of the Pitch Lake, Lake of Trinidad." *Amer. Journ. Sci.* [2], xx. 153.

Dr. Mauross was chiefly chosen to the work of an explorer and engineer of mines. He made extensive journeys in Mexico, Central America, and Venezuela, and was the first to bring to our notice the Auriferous deposits of the Oronoco.

John Dean, Ph.D., of Boston, Mass.—1. Value of Different Kinds of Prepared Vegetable Food. Communicated to the *Am. Acad. of Arts and Sci.*, April 25, 1844.

2. The Organic Compounds of Tellurium and Selenium belonging to the Alcohol Series. Göttingen, 1855.

Henry Draper, of the University of New York, has made the following contributions upon subjects allied to chemistry:—

1. "On the Functions of the Spleen," in 1857.
2. "On the Use of Protochloride of Palladium," read before the British Association in 1857.
3. "On the use of a Silvered Glass Mirror 15½ inches in Aperture in Photographing Celestial Bodies," published in the *Smithsonian Contributions*, 1860.
4. A paper on "Astronomical Photography," in the *London, Edin., and Dub. Phil. Mag.*, 1864.
5. Memoirs on "The Determination of the Wavelengths of the Ultra-violet Spectrum Lines and Diffraction Spectrum Photography," published in the *American Journal of Science*, 1873; the *Philosophical Magazine*, 1873; *Memoire Degli Spettroscopisti Italiani*, 1873; "*Nature*," 1873; *Poggendorf's Annalen*, 1874; and read before the French Academy, and published in the *Comptes Rendus* in full in 1874.

He also revised and republished in 1866 "Draper's Text-Book of Chemistry."

Matthew Carey Lea, Philadelphia, Pennsylvania.—Mr. Lea has been an industrious worker in chemical research as well as in photographic chemistry. His chemical papers are as follows:—

1858. On Picric Acid and its Salts. *Sill. Journ.* [2], xxvi. 379.

1860. Numerical Relations of the Equivalent Numbers of Elementary Bodies. *Ibid.*, xxix. 98, 349; xxx. 399; [3], iv. 387.

1860. Production of Ethylamine. *Ibid.* [2], xxxi. 401.

1860. Optical Properties of Picrate of Manganese. *Ibid.* [2], xxx. 3, 99.

1861. On a Series of New Combinations of Ammonia, Picric Acid, and Metallic Bases. *Ibid.* [2], xxxi. 78.

1861. Sources of Error in the Employment of Picric Acid to Detect the Presence of Potash. *Ibid.* [2], xxxi. 75.

1861. Effects of Reducing Agents upon Nitrate of Ethyl. *Chem. News*, iv. 230.

1861. Estimation of Nitrogen, and on an Acidimetric Process. *Sill. Journ.* [2], xxxi. 189; *Chem. News*, iv. 195.

1861. Exact Separation of the Ethyl Bases. *Sill. Journ.* [2], xxxii. 26; *Chem. News*, iv. 71.

1861. Formation of Picramic Acid. *Sill. Journ.* [2], xxxii. 188; *Chem. News*, iv. 193.

1861. Preparation of Nitrate and Nitrite of Ethyl. *Sill. Journ.* [2], xxxii. 77, xxxiii. 86; *Chem. News*, iv. 219.

1861. Preparation of Urea from Ferrocyanide of Potassium. *Sill. Journ.* [2], xxxii. 179.

1861. Production of Ethyl Bases. *Sill. Journ.* [2], xxxii. 25; *Chem. News*, iv. 88.

1862. Action of Nitric Acid on Picramic Acid. *Sill. Journ.* [2], xxxii. 210; *Chem. News*, v. 18.

1862. Contributions to History of Picric Acid. *Sill. Journ.* [2], xxxii. 180; *Chem. News*, v. 5.

1862. Further Remarks on the Preparation of the Ethyl Bases by means of Nitrate of Ethyl, and their Separation. *Chem. News*, v. 211.

1862. Estimation of Nitrogen. *Ibid.*, v. 28.

1862. Nitrate of Ethyl. *Ibid.*, v. 158.

1862, 1865. Production of New Coloring Matters by Decomposition of Nitronaphthaline and Dinitronaphthaline. *Sill. Journ.* [2], xxxii. 211, xxxiii. 229, xxxviii. 360; *Chem. News*, v. 73, xi. 230.

1862. Production of Nitrate of Methyl. *Sill. Journ.* [2], xxxiii. 227; *Chem. News*, v. 310.

1862. Reaction of Ethyl Bases with Dr. Knop's New Hydrofluosilicic Acid. *Chem. News*, v. 143.

1862. Reaction of Ethylamine and Diethylamine. *Sill. Journ.* [2], xxxiii. 80; *Chem. News*, v. 127.

1862. On Methylamine. *Sill. Journ.* [2], xxxiii. 366; *Chem. News*, vi. 46.

1862. On Triethylamine. *Sill. Journ.* [2], xxxiv. 66; *Chem. News*, vi. 97.

1863. Arithmetical Relations between Chemical Equivalents. *Chem. News*, vii. 63.

1863. On a Constant Aspirator and Blower. *Sill. Journ.* [2], xxxiv. 245; *Chem. News*, vii. 37.

1864. Notes on Platinum Metals and their separation from each other. *Sill. Journ.*, xxxviii. 81; *Chem. News*, ix. 279, 301.

1864. Remarks on the Distillation of Substances of different Volatilities. *Sill. Journ.* [2], xxxvii. 377; *Chem. News*.

1865. Influence of Ozone and some other Chemical Agents on Germination and Vegetation. *Sill. Journ.* [2], xxxvii. 373; *Chem. News*, xi. 229.

1865. On the Platinum Metals. *Sill. Journ.* [2] xxxviii. 248; *Chem. News*, xi. 3, 13.

1865. On the Nature of the Invisible Photographic Image. *Sill. Journ.*, xl. 109; *Chem. News*, xii. 101.

1865. Reaction of Gelatine. *Sill. Journ.* [2], xl. 81; *Chem. News*, xii. 73.

1866. Detection of Iodine. *Sill. Journ.* [2], xlii. 109; *Chem. News*, xiv.

1867. A New Test for Hyposulphites. *Sill. Journ.* [2], lxiv. 222; *Chem. News*, xvi.

1868. On Nitroglucose. *Sill. Journ.* [2], lxv. 381; *Chem. News*, xviii.

1864. Coloration of Faded Photographs. *Sill. Journ.* [2], xxxvii. 438.

1865. Ozone on Insensitive Iodide and Bromide of Silver. *Ibid.* [2], xxxix. 210.

1867. A Theory of Photo-Chemistry. *Ibid.* [2], xliv. 71.

1867. Germination. *Ibid.* [2], xliii. 197.

1867. Light on Iodide of Silver. *Ibid.* [2], xlii. 198.

1869. Transmitted and Diffused Light. *Ibid.* [2], xlii. 364.

1872. Method of Estimating Ethylic Alcohol when present in Mythylic Alcohol. *Ibid.* [3], iii. 365.

1874. A Combination of Silver Chloride with Mercuric Iodide. *Ibid.* [3], vii. 34.

1874. Color and Reduction by Light. *Ibid.* [3], vii. 200.

1874. Laboratory Notes. *Ibid.* [3], vii. 376.

1874. Action of Light on Silver Bromides. *Ibid.* [3], vii. 483.

In addition to the foregoing Mr. Lea has published over one hundred papers on photo-chemical and photographic subjects which have appeared in the British Journal of Photography and other photographic journals. He is also the author of a Manual of Photography, the first edition of which appeared in 1868 and the second in 1871.

Chas. F. Chandler, Ph.D., New York, Professor of Chemistry in the Columbia College School of Mines, etc., has been an industrious working chemist, and charged with numerous responsible duties of administration in the School of Mines and in other educational and public institutions in New York.

He has made the following contributions:—

1. Miscellaneous Chemical Researches.

Inaugural Dissertation for the Degree of Doctor of Philosophy. Göttingen, 1856.

I. Zircon from Buncombe County (North Carolina).
II. Saussurite from Zobten.
III. Stassfurthite from Stassfurth.
IV. Analysis of a rock resembling Talcose Slate, from Zipser.
V. Columbite from Middletown.
VI. Columbite from Bodenmais.
VII. Tantalite from Chanteloube.
VIII. Yttrotantalite from Ytterby.
IX. Samarskite from the Ural.
X. Experiments on the Cerium Metals.
XI. Artificial Heavy Spar.

2. An Investigation on the formation of Alcohol during fermentation. Published in "Biblical Temperance," by E. C. Delavan, Esq.

3. Analysis of Dolomite. In the Report of the Geological Survey of Iowa, by James Hall and J. D. Whitney. Albany, 1858.

4. Examination of Interesting Urinary Calculi, included in a report of Dr. Alden March. Printed in the Annual Report of the N. Y. State Medical Society for 1858.

5. Analysis of Datolith. *Am. Journ. Sci.*, 1859, xxviii. p. 13.

6. A new Metal in the Native Platinum of Rogue River, Oregon. *Ibid.*, May, 1862. p. 351.

7. Analysis of 1 Blende, 2 Smithsonites, 1 Cerusite; and with J. P. Kimball, analyses of 9 Shales, 5 Galenas. 1 Dolomite.

In the Report of the Geological Survey of the Upper Mississippi Lead Region, by Prof. J. D. Whitney. Albany, 1862.

8. Report on Water for Locomotives and Boiler Incrustations, made to the President and Directors of the N. Y. Central R. R., including analyses of Waters between Albany and Niagara Falls, and Analyses of Incrustations. Pamphlet, 8vo. 35 pp. New York, 1865.

9. Report on the Petroleum of the Taro, Italy. 8vo. 8pp. New York, 1866.

10. Sanitary Qualities of the Water Supplies of New York and Brooklyn. Report to the Metropolitan Board of Health. 8vo. 9 pp. New York, 1868.

11. Analysis of the Ballston Artesian Spring. By C. F. Chandler and E. Root. *American Supplement to the Chemical News*, July, 1869, p. 54.

12. A New System of Assay Weights. *Ibid.*, August, 1869, p. 113.

13. Analyses of six New Mineral Springs at Saratoga. *Ibid.*, Sept. 1869, p. 194.

14. Analysis of the Saratoga Seltzer Spring. By C. F. Chandler and Paul Schweitzer. *Ibid.*, Dec. 1869, p. 395.

15. Report on the Quality of the Milk Supply of the Metropolitan District; made to the Metropolitan Board of Health. 8vo. 13 pp. New York, 1870. Also in the *Am. Chemist*, August, 1870, p. 41.

16. Report on the Water Supply of New York and Brooklyn; made to the Metropolitan Board of Health. 8vo. 9 pp. New York, 1870.

17. Report on the Quality of the Kerosene Oil sold in the Metropolitan District; made to the Metropolitan Board of Health. 8vo. 23 pp. New York, 1870.

18. Report on the Gas Nuisance in New York; made to the Metropolitan Board of Health. Including a special discussion of the different methods of purification. 8vo. 109 pp. New York, 1870.

19. Report on Dangerous Cosmetics; made to the Metropolitan Board of Health. 8vo. 7 pp. New York, 1870. Also in *American Supplement to the Chemical News*, May, 1870, p. 293.

20. The Purification of Coal Gas, and the Gas Nuisance in New York. *Ibid.*, February, 1870, p. 117; March, 1870, p. 177.

21. Analyses of the Chittenango Sulphur Springs, Madison Co., N. Y. *Ibid.*, April, 1870, p. 221.

22. Saltness of the Waters around the Island of New York. *Ibid.*, April, 1870, p. 225.

23. A Simple Lecture Experiment to show the Solubility of Carbonate of Lime in Carbonic Acid. *Ibid.*, April, 1870, p. 228.

24. Analysis of the Geyser Spring of Saratoga. By C. F. Chandler and F. A. Cairns. *Ibid.*, June, 1870, p. 373.

25. Lecture on Water; delivered befere the American Institute. 8vo. 49 pp. Albany, 1871.

26. Lecture on Water. (Revised and Elaborated.) *Am. Chemist.*

1. General. November, 1871, p. 161.
2. Mineral Waters. December, 1871, 201.
3. Water for Manufacturing and Domestic Purposes. January, 1872, p. 259. February, 1872, p. 281.
4. The Croton. March, 1872, p. 321.

27. Report on Petroleum as an Illuminator, and the Advantages and Perils which attend its Use, with Special Reference to the Prevention of the Traffic in Dangerous Kerosene and Naphtha; made to the Health Department of the City of New York. 8vo. 110 pp. New York, 1871.

28. Analysis of the Florida Sulphur Spring. *Am. Chem.*, February, 1871, p. 300.

29. Reduction of Nitrate of Silver by Charcoal. *Ibid.*, March, 1871, p. 346.

30. Analyses of Staten Island Waters. By C. F. Chandler and F. A. Cairns. *Ibid.*, March, 1871, p. 347.

31. Composition of Commercial Zinc. *Ibid.*, May, 1871, p. 420.

32. Condensed Milk; its Manufacture and Composition. *Ibid.*, July, 1871, p. 25.

33. Report on the Water of the Hudson River;

made to the Water Commissioners of the City of Albany. A special discussion of the destruction of the sewage contamination of large rivers, caused by the dissolved oxygen. 8vo. 25 pp. Albany, 1872.

34. Report on Petroleum Oil, its Advantages and Disadvantages; made to the Department of Health, (Revised and Elaborated.) *Am. Chem.*, May, 1872, p. 409; June, 1872, p. 446; July, 1872, p. 20; August, 1872. p. 41.

35. Analysis of the Empire Spring at Saratoga. By C. F. Chandler and F. A. Cairns. *Ibid.*, Sept., 1872, p. 93.

36. Analysis of the Glacier Spouting Spring at Saratoga. By C. F. Chandler and F. A. Cairns. *Ibid.*, November, 1872, p. 165.

H. B. NASON, Ph.D., Professor of Chemistry, Rensselaer Institute, Troy, N. Y.—Prof. Nason has published in the German journals some time since papers of which he has supplied only the titles, as follows:—

On the Formation of Ether.

On the Analysis of Meteoric Masses.

On some Minerals of Iceland named by Waltershausen.

On the Mineral called Skeroklas by Sartorius v. Waltershausen.

And subsequently:—

Table for Qualitative Analysis, indicating color of precipitates with diagrams.

Translation, with many additions, of Wöhler's Mineral Analysis.

1873. Elderhorst's Manual of Blowpipe Analysis. Edited with C. F. CHANDLER.

FRANK H. STORER, Bussey Agricultural College, Harvard University, Jamaica Plain, Mass.—Prof. Storer's "Dictionary of Chemical Solubilities," and his "Cyclopedia of Quantitative Analysis," are the constant companions of every American chemist. He has also published the following papers:—

1858. "Behavior of $\dot{Ca}\ddot{C}$ and $\dot{Ba}\ddot{C}$ with various Saline Solutions; on the Determination of Carbonic Acid." *Sill. Journ.* [2], xxv. 41.

1858. On Larves of Flies resisting Arsenic. *Ibid.* [2], xxviii. 166.

1860. On Loss of Light by Glass Shades. *Ibid.* [2], xxx. 420, xxxi. 284.

1860. Review of Antisell on Photogenic Oils. *Ibid.*, xxx. 112, 254.

1861. On Impurities of Zinc. *Ibid.* [2], xxxi. 142, xxxii. 380.

1861. Alloys of Copper and Zinc. *Ibid.* [2], xxx. 286, 423.

1861. Lead in Silver Coins. *Ibid.* [2], xxxi. 430.

1861. Keroselene. *Ibid.* [2], xxxii. 276.

1862. American Process of Working Platinum. *Ibid.* [2]. xxxiii. 124.

1862. Arsenic Eating in Styria. *Ibid.* [2], xxxiii. 126.

1867. Hydrocarbons from Animal Fats. *Ibid.* [2], xxxiii. 250.

1867. Naphtha from Rangoon Petroleum. *Ibid.* [2], xliii. 251.

1869. On Nitric Acid and Chlorate of Potassium as an Oxidizing Mixture. *Ibid.*, xlviii. 190.

1859. Dépôt de soufre dans les tuyaux à gaz. *Rept. de Ch. App.*, 495.

1860. Influence de l'argent sur la durée des doublages. *Ibid.*, 82.

1861. Sur l'extrême difficulté qu'on éprouve à enlever les dernieres traces d'acide carbonique d'une volume considerable d' air atmospherique. *Rept. de Ch. App.*, 205.

1861. La question du pain aéré, description du procédé Horsford. *Ibid.*, 347.

1861. Sur le chromate de chrome et les chromates analogues. *Ibid.*, 390.

1861. Recherche du chrome en présence du fer. *Ibid.*, 58.

1863. Substitution du verre soluble au savon resineux dans la fabrication des savons. *Ibid.*, 5.

1863. Sur les cartouches imperméables de M. Dornbach. *Ibid.*, 91.

1863. Sur la contrafaçon des billets de banque. *Ibid.*, 109.

1865. Hydrocarbon Naphtha obtained from Product of Destructive Distillation of Lime Soap. Jointly with C. M. Warren. *Am. Acad. Bost.*, vii. 1.

1863–64. First Outlines of a Dictionary of Solubilities of Chemical Substances. 1 vol., 8vo., pp. 713.

1863–64. Memoir on the Alloys of Copper and Zinc, 4to., pp. 29.

1866. Ethics of Adulteration. *Harper's Magazine*, xxxii. 635.

1870. Soluble lead-salt and free $\ddot{S}$ in sherry wine. *Chemical News*, xxi. 17.

1870. Assay of Galena. *Ibid.*, xxi. 137.

1870. Examples for Practice in Quantitative Analysis. *Ibid.*, xxii. 89, 187.

1870–73. Cyclopædia of Quantitative Analysis. 8vo., 2 parts, pp. 112 and 113–224.

1874. Bulletin of the Bussey Institution [Jamaica Plain (Boston)]. 8vo., 2 parts, pp. 80 and 81–184. Cambridge.

With Charles W. Eliot.

1874. A Manual of Inorganic Chemistry, arranged to facilitate the Experimental Demonstration of the Facts and Principles of the Science. 1 vol., 8vo.

1874. A Compendious Manual of Qualitative Chemical Analysis. 1 vol., 8vo.

1874. Memoir on the Impurities of Commercial Zinc. 4to., pp. 39.

JAMES P. KIMBALL, PhD., F.G.S., Professor of Geology in Lehigh University.

On Sodalite and Elaeolite from Salem, Mass. *Am. Jour. of Arts and Sciences*, 1859.

A series of analyses of bituminous shales in connection with Prof. C. F. Chandler. Geology of Wisconsin, Vol. I., by Prof. J. D. Whitney.

On Aluminous Magnetite (Emery) and its uses in Iron Metallurgy. *Am. Chemist*, Vol. IV., p. 321.

Dr. Kimball's contributions to science have been mainly geological.

C. GILBERT WHEELER, Prof. of Chemistry in the University of Chicago, Illinois, has made the following contributions to our chemical literature:—

1859. Analysis of various Missouri Coals. *Report of Missouri Geological Survey.*

1865. The Inorganic Constituents of Bavarian Hops and Analyses of the Leading Soils on which they are cultivated. *Journal für Praktische Chemie*, vol. xciv.

1865. A Method of Determining Carbon, Hydrogen, Nitrogen, and Oxygen at one Operation. *Ibid.*, vol. xcv.

1867. On the Action of Zinc and Sulphuric Acid upon Cyanacetic Acid. *Ann. Chem. and Phar.*, vol. cxliii. *Bull. Soc. Chem.* [2], viii. 116.

1867. On the Bisulphide of Phenyl, and the Bisulphide of Brom-phenyl. *Zeitsch. für Chem.*, 1867, pp. 436.

1867. Action of Hypochlorous Acid on Oil of Turpentine. *Bull. Soc. Chim.* [2], x. 288.

1867. Action of Hypochlorous Acid on Camphor. *Zeitsch. Chem.*, 1868. 122.

1866. On a Method of Determining C.H.N+O at one operation. *Am. Jour. Sci. and Arts*, 1866, January number.

1868. Action of Binoxide of Manganese on Uric Acid. *Am. Jour. Sci. and Arts* [2], vol. xliv. p. 218.

1871. Recent Progress in Chemistry in the United States. Read before the British Association at Edinburgh, 1873.

1872. On the Polyscope, a new Optical Instrument. Read before the American Association at Dubuque.

1873. Analysis of Spring Lake and Frankfort Mineral Waters. Published in Dr. Watson's "Mineral Springs of the United States."

1874. Analysis of the Mineral Water of Grand Haven. Completed and about to be published in *Am. Jour. of Sci. and Arts.*

NOTE.—Many of the above were copied into other journals of England, France, and Germany.

C. M. WARREN, Brookline, Massachusetts.—Prof. Warren, formerly of the Massachusetts Institute of Technology, whose researches upon the volatile hydrocarbons are so well known, has made the following contributions to chemistry.

1860. On some Compounds of Zirconia and Titanic Acid.

1. A New Sulphate of Zirconia, containing some Potassa.
2. A Double Sulphate of Zirconia and Potassa.
3. A Double Sulphate of Titanic Acid and Potassa. *Pogg. Ann.*, cii. 449.

1862. On a Safety Heating Lamp for use in Laboratories. *Am. Journ. Sci. and Arts*, [2], xxxiii. 275.

On a Process of Organic Elementary Analysis, by Combustion in a Stream of Oxygen Gas. *Proc. Am. Acad.*, vi. 251.

On a Process of Fractional Condensation Applicable to the Separation of Bodies, having small differences between their boiling-points. *Mem. Am. Acad.*, N. S., ix. 121.

Researches on the Volatile Hydrocarbons:—

1. On the Volatile Hydrocarbons from Coal-tar Naphtha.
2. On the Volatile Hydrocarbons from Oil of Cumin and Cuminic Acid. *Mem. Am. Acad.*, N. S., ix. 135.

On the Influence of CH_2 upon the Boiling-points in Homologous Series of Hydrocarbons, and in some Series of their Derivatives; with critical observations on methods of taking boiling-points. *Loc. cit.*, p. 156.

On a New Process for the Determination of Sulphur in Organic Compounds, by Combustion with Oxygen gas and Peroxide of Lead. *Proc. Am. Acad.*, vi. 472.

On a New Process of Organic Elementary Analysis for substances containing chlorine. *Proc. Am. Acad.*, vii. 84.

Note on an Improved Apparatus for the Determination of Vapor Densities, by Gay-Lussac's Method; being a modification of Bunsen's apparatus for measuring aqueous vapor. *Proc. Am. Acad.*, vii. 99.

In joint authorship with F. H. STORER.

Researches on the Volatile Hydrocarbons:—

Examination of a Hydrocarbon Naphtha, obtained from the Products of the Destructive Distillation of Lime Soap. *Mem. Am. Acad.*, N. S., ix. 177.

Examination of Naphtha, obtained from Rangoon Petroleum. *Loc. cit.*, p. 208.

FREDERICK HOFFMANN, Ph.D., New York.—Dr. Hoffmann's chemical papers and publications are as follows:—

Untersuchungen der Bleiweiss Sorten des Handels. *Hirzel's Zeitschrift für Pharmacie*, 1852–1853.

Untersuchungen der Weinstein Sorten des Handels. *Hirzel's Zeitschrift für Pharmacie*, 1852–3.

Ueber die Ermittlung des Phosphor in der gerichtlich-chemischen Analyse. *Berliner Allgemeine Medicinischs Central Zeitung*, 1859, *Kopp & Will Jahresberichte*, 1859, p. 663.

A Critical Review of the History of Anilin and the Anilin Colors. Sacket & Cobb, New York, 1863.

Die Steinkohlen und deren Destillations Producte. A course of lectures delivered before the New York Gewerbe Verein. *Sonntagsblatt N. Y. Statts Zeitung*, 1863.

Die Chemie und das Leben. A popular lecture. *Butz, Deutsch-Amerikanische Monatshefte*, Chicago, 1864.

Arabesken, am der Geschichte der Chemie. *Butz, Deutsch-Amerikanische Monatshefte*, Chicago, 1864.

Annual Report on the Progress of Pharmacy and Pharmaceutical Chemistry. Philadelphia, 1868.

On the Preparation of Zinc Sulpho-phenate. *Amer. Journ. of Pharmacy*, 1870.

Manual of Chemical Analysis, as applied to the Examination of Medicinal Chemicals. New York, 1873.

Dr. Hoffmann's "Manual," last named, is a work of very high character, and has received well-deserved commendation wherever it is known.

MAURICE PERKINS, Prof. of Chemistry Union College, Schenectady, N. Y.—Prof. Perkins has published An Analysis of the Parotid Saliva, in Dalton's Physiology.

P. B. WILSON, Baltimore, Md.—Mr. Wilson has contributed the following papers:—

1859. 1. On Wax obtained from Myrica cerifera (in Genth's Laboratory).

2. Electro-metallurgical Preparation of Chemically pure Metals, prepared for Bunsen and Kirchhoff, for their Spectroscopic Investigation (in Bunsen's Laboratory).

3. Improvement in the Clark Method for Determining the Hardness of Waters (in Baron Liebig's Laboratory while acting assistant there).

4. Cause of Mono-calcic Phosphate losing its Solubility.

5. On a Meteorite from Hartford County, Maryland (The above were published in *Ann. de Chem. und Pharm*).

S. DANA HAYES, Ph. D., State Assayer of Massachusetts, Boston.—Dr. Hayes is a working chemist, most of whose labors are necessarily hidden in cases in the United States courts, or remain unpublished as the property of those for whom they are made.

But he has found time to make the following contributions.

"A new Lead Salt corresponding to Cobalt Yellow." *Quar. Journ. Chem. Soc.*, and *Am. Journ. Sci. and Arts*. 1861.

"Ueber den Feldspath im geschmolzenen Zustande." *Pogg. Ann.*, Bd. III. S. 351.

"Influence of the Oxides of Chromium and Titanium

on the Composition of Pig-Iron." *Lond. Chem. News*, June, 1869.

"Adulterated Aniline Dyes." *Am. Suppl. to Chem. News*, May, 1870.

"Destructive Distillation of Light Petroleum Naphthas at comparatively Low Temperatures." *Am. Journ. Sci. and Arts*, 3, II. Sept. 1871.

"A common Source of Lead in Drinking Water."
"Assaying One Hundred and Thirty Years ago."
"Some New England Waters."
"Substitution of Soda for Potash in Plants."
} *Am. Chem.*, vol. i.

"History and Manufacture of Petroleum Products."
"Peculiar Conditions of Waters."
} *Am. Chem.*, vol. ii.

"Miscellaneous Chemical Notes," generally appertaining to industrial chemistry. *Am. Chem.*, vols. iii., iv., and v.

JAMES M. CRAFTS, Professor of Chemistry in the Massachusetts Institute of Technology, Boston, Mass.—Mr. Crafts has made numerous researches, chiefly in organic chemistry. His published papers are as follows:—

1861. On the Action of Sulphite of Ammonium on Nitro-benzole (contributed in the name of Professor Carius).

In joint authorship with C. Friedel, Mr. Crafts made in the laboratory of Mr. Wurtz, in Paris, an elaborate investigation on new compounds of silicon with compound radicals, and on the atomic weight of silicon. Notices of these researches were published from time to time in the *Comptes Rendus* and elsewhere, but the final results were given in two memoirs in the *Ann. de Ch. et Phys.*, Paris, as follows:—

1866. Recherches sur les Éthers Siliciques et sur le Poids Atomique du Silicium. *Op. cit.*, 4me série, t. ix. pp. 5–51.

1870. Recherches sur les Combinaisons du Silicium avec les Radicaux Alcoholiques. *Op. cit.*, 4me série, t. xix. 334–367.

[These two memoirs are reproduced in the *Am. Journ. Sci.* [2], xliii. 155–171 and 331–344; xlix. 307–330.]

Mr. Crafts has also published separately in *Comptes Rendus*:—

Sur les Éthers des Acides de l'Arsenic.

Sur les Produits d'Oxydation du Sulfure d'Éthylène.

Sur le Sulfure d'Éthylène et sur une Combinaison qu'il forme avec le Brome.

In the *Am. Journ. Sci.* Prof. Crafts has published as follows:—

1863. Action of Bromine and of Bromhydric Acid on the Acetate of Ethyl, [2] xxxvi. 42.

1864. Note on the Product of the Reaction between the Monosulphide of Potassium and the Bromide of Ethylene, and on the several compounds derived from it, [2] xxxvii. 390.

1865. On the Replacement of one Alcohol Radical by another in Compounds of the Ether class (by C. Friedel and J. M. Crafts), [2] xl. 34.

1865. On Etherification (the same), p. 40.

1869. A Short Course of Qualitative Analysis, with the New Notation, with five Tables. New York. 12mo. 133 pages.

1873. The Estimation of Iron with Hyposulphite of Sodium. *Am. Chem.*, iii. July.

HENRY M. SEELY, Middlebury College, Vermont.—Professor Seely's papers have mostly been on topics not properly chemical, or have been in connection with some other person. We find, however, in the *Berkshire Medical Journal*, 1861, Art. XXXVI., entitled—

Report of a Chemical Analysis of Specimens of Hydrargyrum cum Creta, by Professor Seely, in which he notes the passage of finely-divided mercury, first into black and finally into red oxide of mercury.

JOHN W. LANGLEY, M.D., Professor of Chemistry, W. University of Pennsylvania, Pittsburgh, has published a paper entitled—

1862. On the Detection of Picrotoxine. *Am. Journ. Sci.*, xxxiv., 109, also in *London Medical News*.

B. F. CRAIG, M.D., Washington, D. C.—Dr. Craig has for some years been in charge of the laboratory of Army Medical Museum at Washington.

1861. On the Products from the Combustion of Gunpowder under different pressures. *Am. Journ. Sci.* [2], xxxi. 429.

1861. Report on Nitrification (presented to the Smithsonian Institution in 1858). *Smithsonian Report*, 1861, pp. 305–318.

1864. Remarks on the Production of the Combustion of Gun-Cotton and Gunpowder. *Ibid.*, 1864, pp. 232–234.

1871. Experiments on Ventilation and Composition of Air in Military Barracks. Appended to Surgeon-General Barnes's Report in "Circular No. 4," Washington, 1870. Noticed in *Am. Journ. Sci.* [3], i. 475.

1871. Variations in the Temperature of the Human Body. *Am. Journ. Sci.* [3], ii. 330.

SAMUEL P. DUFFIELD, M.D., Ph.D., Dearbornville, Michigan.—Dr. Duffield's contributions are chiefly in the department of pharmaceutical chemistry, and are as follows:—

Remarks on Analysis of Brandy. *Am. Journ. Pharm.*, March, 1862.

Hypodermic Injections in their Relation to Toxicology. *Proc. Am. Pharm. Ass.*, 1866.

Report on New Remedies. *Detroit Review of Medicine*, 1866.

On Preparation of Pyrophosphate of Iron.

On Proportion of Digitalin in Digitalis grown in different Countries.

On Properties of the Leaves of Podophyllum Peltatum. *Proc. Am. Pharm. Ass.*, 1868.

Emanations from Sewers a Secret Cause of Disease. *Detroit Review of Medicine* 1869.

On Medicinal Fluid Extracts. *Ibid.*, Nov. 1866.

On a Case of Aconite Poisoning. *Proc. Am. Pharm. Ass.*, 1870.

On the Geological Relation of the Mineral Waters of Michigan. *Detroit Review of Medicine*, 1871.

O. D. ALLEN, Professor of Metallurgy in the Sheffield Scientific School, New Haven, Connecticut.—Prof. Allen's researches on Cæsium and Rubidium, and the determination of the atomic weight of cæsium, are well known to all chemists. These memoirs are entitled:—

1862. Observations on Cæsium and Rubidium [in Contributions from the Sheffield Scientific Laboratory, Yale College, iv.]. *Am. Journ. Sci.*, xxxiv. 367–373.

1863. On the Equivalent and Spectrum of Cæsium [in Contributions from the Sheffield Scientific Laboratory, Yale College, v.]. Jointly with Prof. S. W. Johnson (q. v.). *Am. Journ. Sci.* [2], xxxv. 94–98.

GIDEON E. MOORE, Ph.D., Jersey City, New Jersey.—Dr. Moore has published the following original papers:—

1. On the Chemical Constitution of the Wax of the *Myrica cerifera*. *American Journal of Science* [2], xxxiii. 313. May, 1862.

2. On Brushite, a new Mineral occurring in Phosphatic Guano. *Proceedings* of the California Academy of Sciences, September 5, 1864. *American Journal of Science* [2], xxxix. 43.

3. On the Occurrence in Nature of Amorphous Mercuric Sulphide. *Journal für prakt. Chemie*, 1870. *American Journal of Science* [3], ii., January, 1872.

4. On the Electrolysis of the substituted Derivatives of Acetic Acid. *Ber. d. Deutschen chem. Gesellschaft*, May 22, 1871. *American Journal of Science* [3], iii., March, 1872.

P. COLLIER, A.M., Ph.D., Burlington, Vermont., Professor of Chemistry in the University of Vermont, has written chiefly on agricultural chemistry in the daily journals and for the State Agricultural Society, to which he is chemist.

1864. Indirect Determination of Potash and Soda. *Sill. Journ.* [2], xxxvii. 344.

J. M. MERRICK, Boston, 59 Broad Street.—Mr. Merrick's papers are as follows:—

Inhalation of Vapor of Nitroglycerine. *Am. Journ. Sci.*, 1863.

Assay of Gold and Silver. *American Chemist*, vol. i., 1871.

Testing Cochineal. *American Chemist*, vol. i., 1871.

" Indigo. " " " "

Zinc Poisoning. " " " "

Assay of Pyrites for Gold. *American Chemist*, vol. ii., 1872.

Electrolytic Deposition of Nickel. *American Chemist*, vol. ii., 1872.

Separation of Nickel and Copper. *American Chemist*, vol. ii., 1872.

On the Double Chloride of Nickel and Ammonia. (Jointly with ISAAC ADAMS, Jr.) *American Chemist*, vol. ii., 1872.

Electrolytic Determination of Copper. *American Chemist*, vol. iii., 1873.

Estimation of Tannin. *American Chemist*, vol. iii., 1873.

Note on Geissler Bulbs, etc. *American Chemist*, vol. iii., 1873.

Luckow's Method for Determining Copper. *American Chemist*, vol. iii., 1873.

Chemical Experts. *American Chemist*, vol. iv., 1873.

Analysis Crude Sugar. " " " "

Various Chemical Notes. *American Chemist*, vol. iv., 1874.

Estimation of Tannic Acid. *American Chemist*, vol. iv., 1874.

Numerous translations in *American Chemist*.

Analysis of Manures. *Chemical News*, xxiv.

Determination of Copper, Nickel, and Zinc. *Chemical News*, xxiv.

On a New Dye-stuff. *Chemical News*, xxv.

On Testing Cochineal. " "

Various minor notes.

CHARLES PIERCE, Cambridge.—Mr. Pierce's scientific memoirs are mostly mathematical or physical; but the following important paper falls within our scope:—

1863. The Chemical Theory of Interpretation. *Am. Journ. Sci.* [2], xxxv. 78.

ALEXIS A. JULIEN, School of Mines, Columbia College.

1864. On Metabrushite and other Guano Minerals, from Sombrero, W. I. *Am. Journ. Sci.* [2], xl. 367.

1870. On Examples for Practice in Quantitative Analysis. *Am. Chemist*, i. 256, 280, 322, 412.

On a supposed New Mineral from Chesterfield, Mass. *Am. Chemist*, i. 300.

1871. On the Proximate Analysis of Coals. *Am. Chem.*, i. 460.

JOSEPH WHARTON, Philadelphia.—Mr. Wharton does not claim to be distinctly a chemist, but his contributions to the metallurgical arts closely related to chemistry demand respectful mention here, as well as one or two of his papers on other chemical and physical subjects. Mr. Wharton's principal labors have been the establishment in this country of the manufacture of metallic zinc or spelter, and of nickel and cobalt with their immediate products, though he has been largely engaged in lead, copper, iron, and steel.

That he has written little concerning nickel will not surprise those who consider that each of the very few nickel works in the world has to some extent its peculiar processes which cannot prudently be imparted to its rivals. Mr. W.'s nickel is remarkable for purity and uniformity, and comprises about one-sixth of the entire product of the world.

The following papers appear in the *Am. Journ. Sci.*, viz.:—

1865. xc. p. 190. Speculations upon a possible Method of determining the Distance of Certain Variably Colored Stars.

The diverse sensations caused by the several colors being due to the diverse numbers of light-wave impulses therefrom falling upon the retina, and those wave impulses being presumably longitudinal as well as lateral, rapid removal of the retina from the source of light should, by diminishing the number of wave impulses received (as rapid approach should by increasing the same) produce a corresponding change in the color perceived. Supposing the velocities of light answering to certain colors to have been ascertained by experiment, and a variably colored star with a determinable alternation of position to have been sought out—or, better, a pair of binary stars alternately eclipsing each other and of alternating colors—then measure the angle of greatest elongation of the line connecting those stars, and observe the time occupied by them in effecting a reversal of their positions—that is, in traversing a semicircumference of their orbit: equal to $\frac{t}{2}$.

Assume the extreme colors to indicate a difference in the rate of arrival of light impulses, or, in other words, a difference in the velocity of light arriving from the stars when their entire orbital speed is of approach or recession to the spectator equal to $2\,v$.

Then their actual orbital speed $= v$, and, as the orbital period has been found $= t$, it follows that $\frac{v \times t}{3{\cdot}1416}$ is the real length of that diameter, which is the measured angular distance between the extreme positions of the stars. Knowing the angle and the length of the subtending base, we have the distance of the stars.

1869. xcvii. p. 251. Observations upon Autumnal Foliage. Conceiving that the autumnal change from green to red might be due to the acidifying influence of atmospheric oxygen upon the leaf sap after the vitality

of the leaf is lost or is destroyed by frost, thus enabling the thin acid sap to redden the vegetable blue element of the chlorophyl, Mr. W. undertook as a test of this supposition to reverse the process by immersing red autumn leaves in an alkaline atmosphere. The red leaves of sassafras, blackberry, maple, oak, etc., were restored to a green color, by leaving them under a bell-glass wherein ammonia was evaporating for periods of a few minutes, varying with the impermeability of the cuticle of the leaf.

1870. xcix. p. 365. On two Peculiar Products in the Nickel Manufacture. One of those products being basic crystals of iron, nickel, and cobalt sulphide, found in the matte furnaces of Gap Mine, having the unusual formula R_6S. The other being metallic bubbles or hollow spheroids formed on pouring melted nickel-copper alloy into water, the gases contained in a drop of metal sufficing to distend it into a bubble while cooling.

1871. cii. p. 168. Memoranda concerning the Introduction of the Manufacture of Spelter into the United States. This paper gives a detailed account of the establishment of this manufacture, with statements of materials consumed, cost, and product. After some preliminary experiments, Mr. W. erected at Bethlehem, Pa., in the year 1860, a spelter works of sixteen Belgian furnaces with all appurtenances, stipulated to produce 3,000,000 lbs. yearly, but which exceeded that quantity in 1861, and produced in 1862 over 3,700,000 lbs.

The zinc or spelter was of most excellent quality, and was made so cheaply as to afford a reliable profit, and to plant this industry firmly in this country.

The original features of the enterprise were: 1. The reduction to metal, on a large scale, of silicate of zinc, which had theretofore not been effected. 2. The successful application of anthracite to the manufacture of spelter, instead of the bituminous coal or wood which European practice had apparently shown to be indispensable. 3. The use of American clays for the making of zinc retorts.

SAMUEL D. TILLMAN, New York, 11 Cooper Union.—Mr. Tillman's contributions to chemical literature have been mainly in the department of chemical philosophy. His published papers are as follows:—

A New Chemical Nomenclature. See *Transactions of American Institute* for 1865–6, pp. 670–692. Applicable to more than 7000 bodies, each name indicating the exact composition of the body designated.

Chemical Diagrams and Derivative Symbols, illustrating the Prominent Characteristics of Chemical Elements. *Proceedings of the American Association for the Advancement of Science*, for 1867.

Atoms and Molecules. *Am. Chem.* for April, 1872 and *Nature* (London) for June, 1872.

CHARLES U. SHEPARD, Jr., M.D., Charleston, S. C. —Dr. Shepard has published the following memoirs:—

1866. On the Origin of Hippuric Acid in the Animal Organism. This is a small volume published in joint authorship with Prof. George Meissner, of Göttingen, Hanover, 1866.

1867. On the Change of Benzoic Acid in the Organism of Birds. *Zeitschrift der Ration. Medicin.*

1869. Notes on the Occurrence and Composition of Nodular Phosphates of South Carolina. *Am. Journ. Sci.* [2], xlvii. 354-364.

Dr. Shepard has published some other communications, the titles to which I have not been able to obtain.

JAMES F. BABCOCK, Boston, Mass. (No. 8 Boylston St.), Boston University.—Prof. Babcock has published as follows:—

1866. On the Preparation of Sulphocyanide of Potassium. *Lond. Chem. News*, vol. xiv., 1866.

1866. On the Preparation of Iodide of Ammonium. *Proc. Am. Pharm. As.*, Philadelphia, 1866.

1867. On Beeswax. *Proc. Am. Pharm. As.*, Philadelphia, 1867.

1872. Reports on the Adulteration of Milk. *City of Boston*, 1870, 1871, 1872.

1873. On the Adulteration of Milk. *Report of the State Board of Health*, State of Massachusetts, 1873.

1874. On the Impurities of Commercial Iodide of Potassium. *The Laboratory*, Sept. 1874.

Report on the Preservation of Wood Pavements. *City of Boston*, 1873.

H. CARRINGTON BOLTON, Ph.D., School of Mines, Columbia College, New York.—All Dr. Bolton's contributions to chemistry fall within the last eight years. The following list does not embrace Dr. Bolton's latest contribution, for which he has placed us all under lasting obligations. I allude to his happy thought of memorializing the day we celebrate, for it is to him we owe the pleasure of this gathering at the grave of Priestley to-day.

1866. On the Fluorine Compounds of Uranium. Monatsb. der Berlin. Academie, 1866, p. 299. Also as pamphlet 40 pp.

1869. On the Action of Sunlight on Uranium. *Am. Journ. of Sci.*, Sept. 1869.

1870. Index to Literature of Uranium. Annals New York Lyc. Nat. Hist, vol. ix., p. 362.

History of the Defunct Elements. *Am. Chemist*, vol. i., p. 1.

Extraction of Uranium. *Ibid.*, vol. i., No. 2. August, 1870.

1872. Observations on the Platino-Cyanide of Magnesium. *Ibid.*, vol. ii., No. 10.

On Galvanic Action in the Mouth. *Dental Cosmos*, vol. xiv., p. 298.

1873. Washing Bottles a Cause of Fire. *Am. Chemist*, vol. iii., p. 286.

Views of the Founders of the Atomic Philosophy. *Ibid.*, vol. iii., p. 326.

With Prof. Henry Morton: Investigation of Fluorescent and Absorption Spectra of Uranium Salts. *Ibid.*, vol. iii., p. 361, *et seq.*

Zettnow's Scheme for Qualitative Analysis. *Ibid.*, vol. iii., p. 452.

Notes on the Early Literature of Chemistry. Four papers. *Ibid.*, vol. iv.

1874. Chemical Paradoxes. *Journ. of Appl. Chem.*, June, 1874.

LE ROY C. COOLEY. Ph.D., Albany, New York—Prof. Cooley, of the State Normal School, has published the following:—

On Teaching Advanced Classes in Chemistry. Read at "University Convocation," etc., published in *Proc. of Third Anniv.*, 1866.

On Elementary Chemistry in Preparation for College. Read at "University Convocation," published in *Proc. of Fifth Anniv.*, 1868.

On a Steady Air-Blast for Laboratory Purposes. *Journ. Frank. Inst.*, vol. lxv., 1870.

On a Blowpipe Assay with the Automatic Air-Blast. *Ibid.*, vol. lxi., 1871.

On the Effect of the Action of Water on Gypsum. *Proc. Albany Inst.*, vol. i., Part I., 1870.

Report on the Progress of Chemistry, 1871. *Trans. of Albany Institute*, vol. vii.

"From Newton to Kirchoff" (sketch of spectrum analysis), 1872. *Ibid.*, vol. vii.

John M. Blake, New Haven, Connecticut.—Mr. Blake's contributions are chiefly mineralogical and physical. We note the following:—

1866. On Measuring Angles of Crystals.
1866. Gaylussite from Nevada.
1867. Natural Terpin.
1867. On Kaolinite and Pholerite.
1869. On Hortonolite.

All in the 2d series of the *Am. Journ. Sci.*

H. Endemann, Ph.D., New York. Dr. Endemann has contributed the following papers:—

1866. Die neutralen und sauren Aether der schwefligen Säure. *Annalen der Chemie und Pharmacie.*

1872. Meat and the Methods of Preserving it. *Am. Chemist*, January.

1869 to 1872. Disinfectants and Disinfection. Reports of the Health Department of the City of New York.

1872. Confectionery sold in the City of New York. Report of the Health Department of the City of New York.

1872. Examination of the Air in Schools, Manufactories, Tenements, Cellar Lodgings, Prisons, Theatres, and Public Halls in the City of New York. Report of the Health Department of the City of New York.

1873. Also another series. *New York World*, Dec. 27.

1872. Chemical and Mycological Examination of the Blood, Bile, and Urine of Horses sick with the Epizootic Influenza. Report of the Health Department of the City of New York.

1874. Warming and Ventilation. *Sanitarian*, April.

North Carolina Prisons. *Annals of the Lyceum of Natural History*, N. Y. vol. ix.

1874. Criticisms of Prof. Wurtz's Test for Free Oxygen in Water. *Am. Chemist*, July.

S. P. Sharples, Boston (114 State Street).—Mr. Sharples has published:—

1866. Chemical Tables. 8vo. pp. 192.

Papers in the *American Journal of Science*—

1868. On some Minerals from Chester County, Pennsylvania.

1869. On a New Salt, containing Tin, Calcium, and Chlorine (March).

1871. On some Dredgings from the Gulf Stream (February).

1871. On some Forms of the Galvanic Battery (April).

1874. Crystals of Zinc (March).

Papers in the *American Chemist*—

1872. The Waters of Eastern Massachusetts (November).

1873. The Disposal of Animal Refuse: and several shorter articles.

Papers in *Journal of Applied Chemistry*—

1873. On the Preservation of Food (August).

1874. On Common Salt (September).

Mr. Sharples has also, since 1871, been a constant contributor to the *Boston Journal of Chemistry*, of which journal he is assistant editor, having been previously (1866) a graduate of the Lawrence Scientific School, Cambridge; assistant (1867-8) at Lehigh University; assistant (1868-71) at Lawrence Scientific School; and (1872) State Assayer of Massachusetts. Dr. Sharples's Chemical Tables are in the hands of all American chemists.

George F. Barker, Professor of Physics in the University of Pennsylvania, Philadelphia, has published the following chemical and physical papers:—

Theoretical Chemistry.

On Normal and Derived Acids. *Am. Journ. Sci.*, Nov. 1867.

Formic *versus* Carbonous Acid. *Ibid.*, Sept. 1867.

On the Rational Formulas of the Oxides of Chlorine and of Oxides analogously constituted. *Am. Chem.*, July, 1871.

On Molecular Classification. *Ibid.*, April, 1871.

Physics.

Note on the Spectrum of the Aurora. *Am. Journ. Sci.*, Dec. 1871.

On the Aurora of October 14th, 1872. *Ibid.*, Feb. 1873.

Toxicology.

Report of a Trial for Poisoning by Strychnia. *Am. Journ. Med. Sci.*, Oct. 1864.

Testimony in the Sherman Poisoning Case. *Am. Chem.*, June, 1872.

Dr. Barker has also contributed valuable abstracts of chemical researches, chiefly from European journals in the *Am. Journ. Sci.*, since volume xlv. of the second series (1868). Also, a series of "Notices of papers in Physiological Chemistry." *Am. Journ. Sci.* [2], xlvi. 233-379; xlvii. 20, 258, 393; xlvii. 49.

"A Text-Book of Elementary Chemistry, Theoretical and Practical," 12mo., which has met deservedly with great favor as a clear exposition of the "New Chemistry."

The *Journal of the Franklin Institute* is now under the editorial care of Dr. Barker.

Edward W. Root.—The late Prof. Root, of Hamilton College, has published the following chemical papers:—

1867. "On Wilsonite from St. Lawrence County, N. Y." *Am. Journ. Sci.* [2], xlix. 47.

1868. "On Enargite from Mercury Star Mine, California." *Ibid.*, xlvi. 201.

Prof. Root died, in his 30th year, in November, 1871, highly esteemed for his scientific and literary attainments, integrity of character, and tested ability.

Beverly S. Burton, Ph.B., has published ("Contributions from the Sheffield Laboratory of Yale College, No. xvi.")—

1867. "Contributions to Mineralogy" with Analyses of: i. Enorgite from Colorado; ii. Argentiferous Jamesenite from the Sheba Mine, Star City, Nevada; iii. Argentiferous Tetrahedrite from the De Soto Mine, Nevada (the 2d and 3d collected in 1864 by B. Silliman). *Am. Journ. Sci.* [2], xlv. 34.

U. J. Knowlton, Rockport, Mass.—"On a New Mineral from Rockport, Mass." An altered zinc ore. *Am. Journ. Sci.* [2], lxix. 224. 1867.

S. F. Peckham, Minneapolis, Minnesota, University of Minnesota.—Professor Peckham's papers are:—

1867. On the Supposed Falsification of Samples of

California Petroleum. *American Journal of Science*, May, 1867.

1867. On a New Apparatus for Technical Analysis of Petroleum; together with Experiments upon the Formation of Asphaltum. *American Journal of Science*. September, 1867.

1868. Notes on the Origin of Bitumens. Read before the Natural Academy of Sciences, August, 1868. Published in the *Proceedings* of the American Philosophical Society, x., 441.

1869. On the Distillation of Dense Hydrocarbons at High Temperatures, technically termed "Cracking." *American Journal of Science*, January, 1869.

1869. On the Probable Origin of Albertite and Allied Minerals. *American Journal of Science*, November, 1869.

1871. Evaporating Niches at the Laboratory of the Maine State College of Agriculture and the Mechanic Arts. *American Chemist*, August, 1871. *Proceedings* of the American Association for Advancement of Science, 1871.

1873. American Asphalts. *American Chemist*, July, 1873.

Four reports to the State Geologist of California, which have been printed, but not yet published:—

1st. 1866. On the Oil Interests of Southern California.

2d. 1867. On the Results of a Technical Examination of California Bitumens.

3d. 1871. On the Results of an Examination of California and other Petroleums in Reference to their Ultimate Chemical Composition. Made at Cambridge in 1869.

4th. 1872. On the Results of Proximate Analyses of California and other Coals, and a Quantitative Determination of the Sulphur contained in them. Made in Providence in July, 1872. Also—

1873. Report to State Geologist of Minnesota in Report of Board of Regents of the State University of Minnesota.

1874. Peat for Domestic Fuel. Report to Geological Secretary of Minnesota, July, 1874.

P. Casamajor, Williamsburg, New York.—Mr. Casamajor's papers, partly physical, partly chemical, are as follows:—

1867. On the Method of Measuring the Angles of Crystals by Reflection without the Use of a Goniometer. *American Journal of Science*, September.

1870. Action of Water on Lead. *American Chemist*, July.

1871. On the Purification of Sugar Solutions for the Optical Saccharometer. *American Chemist*, November.

1872. Researches on Voltaic Batteries. *American Chemist*, May, June, and July.

1873. Testing Sugar Solutions by Means of Areometers and the Optical Saccharometer. *American Chemist*, October and November.

1874. On the Formula of Francoeur for Correcting the Indications of Beaumé's Areometer into Corresponding Specific Gravities. *American Chemist*, February.

1874. New Portable Apparatus which may be used as a Filter Pump or Laboratory Bellows. *American Chemist*, April.

1874. On the Expansion of Sugar Solutions by Heat. *American Chemist*, June, 1874.

W. Goold Levison, Brooklyn, New York.—Mr. Levison has contributed the following papers:—

Letters on the Properties of Sodium Amalgam. Dated New York, June 11, 1867. Published in the *American Journal of Mining*, June 15, 1867, vol. iii., No. 12.

Letter on the Action of Sodium in the Pan. Dated New York, July 16, 1867. Published in the *American Journal of Mining*, July 20, 1867, vol. iv., new series, No. 3.

Paper on the Peat Deposits of Prospect Park. Read before the Natural History Department of the Long Island Historical Society, February 28, 1867.

Letter on an Improvement in Galvanic Batteries. Dated Cambridge, Massachusetts, May 1, 1870. Published in the *Journal of the Franklin Institute*, June, 1870, vol. lix., No. 6.

Paper on the Precipitation and Determination of the Metals of the Magnesian Group in the Form of Oxalates. Lawrence Scientific School Contributions, No. 12. *American Journal of Sciences*, September, 1870, vol. l., No. 149.

Note on an Improved Screw Cup and a New Connector for Volta-Electric Instruments. Read before the Lyceum of Natural History in the city of New York, November 11, 1872.

Note on the Production of Ammonia in Nitric Acid Batteries. Read before the Lyceum of Natural History in the city of New York, March 10, 1873. Published in the *Journal of the Franklin Institute*, May, 1873, vol. xlv. No. 5. Republished, with corrections, in the *Proceedings* of the Lyceum of Natural History for 1873.

Note on a Simple Connector for Battery Carbons. Read before the Lyceum of Natural History in the city of New York, April 13, 1874.

O. Loew, Smithsonian Institution Laboratory, Washington, D. C.

Mr. Loew's contributions to chemistry are in the *Am. Journ. of Sci.*, as follows:—

1867. Action of Water on Carbo-Hydrates. [2], lxiii. 371.

1868. Ferrocyanide of Potassium on Monochloracetic Ether. [2], lxv. 383.

1868. Nitrate of Ammonia. [2], lxvi. 29.

1868. Bisulphid of Carbon in Sunlight. [2], lxvi. 363.

1869. Derivatives of tri-chlormethyl-sulphon-chlorid. lxvii. 350.

1870. Action of Sunlight on Sulphurous Acid. [2], lxix. 368.

1870. Ozone from Rapid Combustion. [2], lxix. 369.

1870. On Hydrogenium-amalgam. [2], l. 99.

1874. On Wheelerite, a New Fossil Resin. [3], vii. 571.

Isidor Walz, Ph.D., New York, has published the following chemical papers:—

1868. On the Oxidation of Diamylene by means of Chromic Acid. *Sill. Am. Journ. of Sci.*, 2, xlv. 57.

1870. A Modification of Bunsen's Filtering Pump. *Chem. News*, 22, 163.

Notes on the Extinctive and Reducing Powers of Mercury. *Ibid.*, 22, 217.

1870. On the Reduction of Sulphuric Acid by Zinc Amalgam. *Amer. Chemist*, i. 242.

1870. On the Reaction of Chloral Hydrate and Sulphide of Ammonium. *Ibid.*, i. 441.

1871. Determination of Moisture in Bone-black. *Ibid.*, ii. 169.

1872. On the Action of Chromium Trioxide on Iodine. *Ibid.*, iii. 84.

1873. On Antimony Terchloride as a Reagent for Oils. *Ibid.*, iv. 169.

A series of articles "On Chemistry applied to Textile Arts and Dyeing," of which eighteen chapters have appeared in *The Manufacturer's Review and Industrial Record* since 1872, and which, when finished, will be collected in a volume.

Frank W. Clarke, S.B., University of Cincinnati, O.—Prof. Clarke has made the following contributions to chemistry:—

1868. On New Processes in Chemical Analysis. *Am. Journ. Sci.*, xlv. 173.

1869. Upon the Atomic Volume of Liquids. *Am. Journ. Sci.*, xlvii. 180.

1869. Upon the Atomic Volume of the Elements. *Am. Journ. Sci.*, xlvii. 308.

1869. A Qualitative Separation of Cobalt and Nickel. *Am. Journ. Sci.*, xlviii. 67.

1870. On a New Method of Separating Tin from Arsenic, Antimony, and Molybdenum. *Am. Journ. Sci.*, xlix. 48.

1870. On the Atomic Volume of Solid Compounds. *Am. Journ. Sci.*, l. 174.

1870. An Examination of the Doctrine of Atomicity. *Am. Chem.*, November.

1873. Evolution and the Spectroscope. *Pop. Sci. Month.*, Jan.

1874. The Constants of Nature; Smithsonian Miscellaneous Contributions, Part I.; Specific Gravities; Boiling and Melting-points; and Chemical Formulæ, pp. 203. 8vo. *Smith. Inst.*

1874. On the Molecular Volume of Water of Crystallization, and—

1874. On the Molecular Heat of Similar Compounds. *Am. Jour. Sci.* [3], viii.

W. G. Mixter, Instructor in Chemistry, Sheffield Scientific School, Yale College.—Mr. Mixter's chemical papers are:—

1868. "On Nillemite and Tephroite" (from Mine Hill, Sussex, New Jersey, with Analyses). *Am. Journ. Sci.* [2], xlvi. 230.

1872. "On the Estimation of Sulphur in Coal and Organic Compounds." *Ibid.* [3], iv. 90.

1873. In connection with E. S. Dana, "On the Specific Heat of Zirconium, Silicon, and Boron." *Ann. Chem. u. Pharm.*, Bd. 195, 388, and *Am. Journ. Sci.* [3], 506, Abstract.

William H. Chandler, Professor of Chemistry in the Lehigh University, Bethlehem, Pennsylvania, has published the following chemical papers:—

The Economical Purification of Zinc, containing Iron. *American Supplement to American Reprint of Chemical News*, Sep. 1869, p. 193.

On the Determination of Sulphur Compounds in Mineral Waters. *Ibid.*, April, 1870, p. 221.

Production of Iodine and Bromine. *Am. Chem.*, vol. i. p. 47.

Carbon Photographs. *Ibid.*, vol. i. p. 94.

The Sherman Process for Refining Iron. *Ibid.*, vol. i. p. 366.

The Peruvian Guano Islands. *Ibid.*, vol. i. p. 439.

A Day in Dublin. *Ibid.*, vol. ii. p. 88.

Henry Morton, LL.D., President of Stevens Institute of Technology, Hoboken, New Jersey.—Most of Prof. Morton's papers are more properly physical than chemical, but the following fall within our scope.

1869. Research on the bright line beyond the Moon's Edge, in partial phase eclipse photographs. *Comptes Rendus, French Acad.*, V. lxix. p. 1234. Also *Journ. Frank. Inst.*, lviii. 373.

This research demonstrated that this phenomenon was a result of chemical reaction, a "local re-development" of the image. as Dr. Morton called it, and that consequently the views of Airy and Prest. Barnard, that it was either subjective or from diffraction, was no longer tenable.

1872. Researches on Anthracene and Chrysogen. *Am. Chemist*, Sept., and *Phil. Mag.*, Sept., p. 345.

1872. Research on Certain New Solid Hydrocarbons in Petroleum Distillates, "Thallene and Petrollucene." *Am. Chemist*, Nov., and *Phil. Mag.*, V. xlvi. p. 89, *Revue Scientifique*, *Chem. News*, etc.

1872–73. On Fluorescent and Absorption Spectra of Uranium Salts, a series of papers running through the *Am. Chemist*, vols. iii. and iv. In joint authorship with Dr. H. Carrington Bolton.

1873. On Basic Salts of Uranium. *Am. Chemist*, iv. 125; also *Revue Scientifique*, etc.

1874. On Pyrene and Chrysene. *Am. Chemist*, current Nos.

Rossiter W. Raymond, Ph.D.. New York City.

1869. Dr. Raymond's Annual Reports as U. S. Commissioner of Mines since 1869 have been an important contribution to technical literature, and especially to metallurgists.

Dr. Raymond has also established the *Engineering and Mining Journal*, which for about ten years has been a principal authority in all chemical matters relating to the smelting and assay of ore, and has done a good work for practical science generally. One who is absorbed by such editorial labors finds little time for original research, but Dr. Raymond has contributed an important memoir upon the Tertiary and Cretaceous lignites of Western America, entitled—

1873. Calorific Value of the Lignites of Western America. *Engineering and Mining Journal*, and *Am. Journ. Sci.* [3], vi. 220.

Albert H. Gallatin, M.D., 10 E. 17th Street, New York.—The only original paper by Dr. Gallatin which I have seen is entitled—

On Hydrogenium Alloys. *Phil. Magazine*, London, July, 1869.

Paul Schweitzer, Ph.D., Professor of Chemistry, Columbia, Boone County, Missouri, has published the following chemical papers:—

I. On Tribasic Phosphoric Acid; its history, its modes of separation from sesquioxides, principally sesquioxide of iron, and its estimation. *Annals of the Lyceum of Natural History of New York*, vol. ix. Nos. 5 and 6, 1869.

II. On the Quantitative Separation and Determination of Iodine, Bromine, and Chlorine. *Chemical News*, American reprint, vol. v. p. 317, 1869.

III. The Various Methods for the Determination and Separation of Baryta, Strontia, and Lime; also, some Remarks on the Precipitation of Sulphuric Acid by Salts of Baryta (five papers). *Chemical News*, American reprint, vol. vi. pp. 119, 222, 295, 370, 1869; *Am. Chem.*, vol. i. p. 9, 1870.

IV. Analyses of Pure Lead. *Proceedings of the Lyceum of Natural History of New York*, p. 8, 1870.

V. Kresol and Phenol and their Homologues. *Am. Chem.*, vol. i. p. 239, 1871.

VI. Notice of a Curious Boiler Deposit. *Am. Chem.*, vol. i. p. 287, 1871.

VII. On the Action of Sulphurous Acid on Metals. *Am. Chem.*, vol. i. p. 296, 1871.

VIII. Notes on the Feldspathic Sandstones (Felsites) of the Palisade Range. *Am. Chem.*, vol. ii. p. 23, 1871.

IX. Contributions to the Mineralogy of Manhattan Island. *Am. Chem.*, vol. iv. p. 443, 1874.

X. Columbia Chalybeate Spring. *Report University of Missouri*, 1874, p. 160.

XI. On the Water Supply of the Town of Columbia. *Report University of Missouri*, 1874, p. 161.

XII. Action of Rain-Water on Lead Pipes. *Report University of Missouri*, 1874, p. 163.

WM. RIPLEY NICHOLS, Professor of Chemistry at the Massachusetts Institute of Technology, Boston, has published:—

On the Chromites of Magnesium. *Am. Journ. Sci.*, xlvi. 16, 1869.

On the Composition of the Acid Oxalates of Potassium, Ammonium, and Sodium. *Proc. Am. Assoc.*, xviii. (1869), 159.

On the Solubility in Water of the Oxalates of Sodium, Potassium, and Ammonium. *Proc. Am. Assoc.*, xviii. (1869), 163.

Report on the Action of Cochituate Water on Lead Pipes. *Mass. State Board of Health, 2d Annual Report*, 1871, p. 32.

In connection with GEO. DERBY, M.D.:—

Sewerage; Sewage; The Pollution of Streams; The Water Supply of Towns. A Report to the State Board of Health of Massachusetts. *Mass. State Board of Health, 4th Annual Report*, 1873, p. 12.

On the Present Condition of Certain Rivers of Massachusetts, together with considerations touching the water supply of towns. *Mass. State Board of Health, 5th Annual Report*, 1874, p. 61.

J. BLODGETT BRITTON, Philadelphia.—In his capacity of Chemist to the "Iron Masters' Laboratory" 339 Walnut Street, Philadelphia, Mr. Britton has performed a great amount of technical work in the Analysis of Iron Ores, Furnace Products, etc. etc., which need not be given in detail here. But the following papers come properly in as contributions to chemistry.

1870. 1st. "A Method for determining quickly and accurately the Amount of Chromium and Iron in Chrome Iron Ores." *Journal Franklin Institute* for March, 1870.

2d. "Mounted Burettes for Volumetric Analysis." *Journal Franklin Institute* for May, 1870.

3d. "The Determination of Combined Carbon in Iron and Steel by the Colorimetric Process." *Journal Franklin Institute* for May, 1870.

ALBERT B. PRESCOTT, Professor of Applied Chemistry, University of Michigan, Ann Arbor, Michigan, has contributed as follows to our chemical literature:—

Simple Apparatus for Rapid Vaporization at limited heat under reduced pressure without use of pump. *Chem. News*, xx. 222 (1870).

On Sulphophenic Acid. *Proc. Am. Pharm. As.*, xix. 550 (1871).

And in joint authorship with Prof. SILAS H. DOUGLASS, Prof. Prescott has published—

Qualitative Chemical Analysis, a guide in the practical study of chemistry, and in the work of analysis. 8vo. pp. 260. 1872.

ARNOLD D. HAGUE, New York.—Mr. Hague, who has long been connected with the United States Geological Exploration of the 40th Parallel, is the author of a paper—

1870. On the Chemistry of the Washoe Process of Amalgamation. This paper forms part of vol. iii. "Mining Industry" of the Reports of the United States Geological Exploration of the 40th Parallel, 4to. 1870.

SAMUEL P. SADTLER, Professor of General Chemistry in the University of Pennsylvania, Philadelphia, has published the following papers on chemistry:—

On Potassio-cobaltic Nitrites, with analogous and related compounds. *Am. Journ. Sci.*, March, 1870.

On some Iridium Salts. *Inaugural Dissertation*, Göttingen, April, 1871.

Abstract of the same Work. *Am. Journ. Sci.*, Nov. 1871.

Analytical Notices of New Processes. *Am. Journ. Sci.*, March, 1874.

J. M. SILLIMAN, Lafayette College, Easton, Pa.—Prof. Silliman has published—

1870. Examination of the Bessemer Flame with Colored Glasses, and Spectroscopic Examination of the Bessemer Flame. *Am. Journ. Sci.*, l. 297, and *Proc. Am. As.*, xix. 119.

SIDNEY A. NORTON, Columbus, Ohio, Ohio Agricultural and Mechanical College.

1870. "On a Bichloride of Platinum + $5H_2O$." This salt is less deliquescent than the ordinary salt, and is a new form. *Journ. fur Prakt. Chem.*, Bd. 2, S. 469.

1872. A second paper on the same. *Ibid.* Bd. 5. S. 365.

RICHARD H. LEE has published ("Contributions to Chemistry from the Laboratory of the Lawrence Scientific School, No. 16") an important paper, entitled—

1871. "On the Atomic Weights of Cobalt and Nickel." *Am. Journ. Sci.* [3], ii. 44.

THOMAS M. CHATARD has published ("Contributions to Chemistry from the Laboratory of the Lawrence Scientific School, No. 15") a valuable contribution—

1871. "On some New Analytical Methods: § 1. On the Determination of Molybdic Acid as Plumbic Molybdite. § 2. On the Evaporation to Dryness of Gelatinous Precipitates (a former paper of M. Chatard's on this subject is printed in *ibid.* i. 247). § 3. Tests for Nitrous Acid. § 4. On the Determination of Small Quantities of Manganese." *Am. Journ. Sci.* [3], i. 416.

CHARLES E. MUNROE, Professor of Chemistry, etc., U. S. Naval Academy, Annapolis, Md.—Prof. Munroe has published:—

"On the Estimation of Phosphoric Acid." *Am. Journ. Sci.* [2], i. 359. 1871.

"On the Use of a Porous Cone in Filtration." *Ibid.* 336. Also reproduced in Fresenius' *Zeitschrift*.

ELWYN WALLER, School of Mines, Columbia College, New York.—Mr. Waller has published:—

1872. Notes on the Petroleum of St. Domingo. *Am. Chem.*, ii. 220.

1872. Application of Osmose to Purification of Sugars. *Ibid.*, iii. 139.

1872. Coal Tar Colors. *Ibid.*, ii. 9.

Also, in the Report of the New York Board of Health for 1872:—

Report on the Croton Water, for the year 1872.

Report on Baking Powders, etc.

Report on Disinfection and Disinfectants. A paper read before the American Public Health Association, November, 1873.

Carbolic Acid, Tests of its Presence, and a New Method for its Quantitative Estimation. *Sanitarian*, November, 1874.

Mr. Waller, as one of the editors of the *American Chemist*, is a constant contributor, by his abstracts of chemical literature, foreign and domestic.

Edwin J. Houston, Philadelphia, Pennsylvania, has contributed the following original memoirs:—

On the Change of Color produced in Certain Chemical Compounds by Heat. *Journal of the Franklin Institute*. vol. lxii., No. 2, August, 1871.

Color Changes produced in Chemical Compounds by Solution. (Unpublished.) Read before the Optical Section of the Franklin Institute during the winter of 1872.

On the Nature of White Light. *Journal of the Franklin Institute*. 1873.

On the Artificial Production of Cold. *Journal of the Franklin Institute*, 1873.

On a Supposed Allotropic Modification of Phosphorus. *American Phil. Society Proceedings*. Read January, 1874.

Prof. Elihu Thomson, of Philadelphia, was jointly associated in the first and last of the above investigations.

Arthur W. Wright, New Haven.—Dr. Wright, Professor of Chemistry and Molecular Physics at Yale College, is the author of important researches in physics. The following are his chemical contributions:—

1. On a simple Apparatus for the Production of Ozone with Electricity of High Tension. *Am. Journ. Sci.*, iii. vol. iv., July, 1872.

2. On the Action of Ozone upon Vulcanized Caoutchouc. *Ibid.*

3. On the Oxidation of Alcohol and Ether by Ozone. *Ibid.*, vol. vii., March, 1872.

A. Emerson Dolbear, Bethany, West Virginia.—Prof. Dolbear's contributions to chemistry are—

1872. A Method of obtaining Potassium. *American Chemist*, February, 1872.

1874. On the Use of Iron Sulphide as a Disinfectant and Deodorizer. *Scientific American*.

A. E. Foote, Professor of Chemistry in the Iowa State Agricultural College, Ames, Iowa, has published as follows:—

1872. Zeonochlorite, a new hydrous silicate from Nupigon Bay, north shore of Lake Superior. *Am. As. Proc.*, 1872; republished in *Am. Chem.*, vol. p.

1873. A Modification of the (Jagn) Vacuum or Filter Pump, that can be used with from three to five feet fall of water, and does not easily get out of repair. *Proc. Am. As.*, 1873, p. 141; also *Am. Journ. Sci.*, 3d ser., vi. 360; and likewise *Am. Chem.* and *Journ. Frank. Inst.*

E. S. Dana, Yale College, New Haven, Conn., has contributed as follows:—

"On the Composition of the Labradorite Rocks from Waterville, N. H." *Am. Journ. Sci.* [3], vol. iii. 48.

Also the following mineralogical and physical papers:—

"On Datolite from Bergen Hill." *Am. Journ. Sci.* [3]. vol. iv. p. 16. 1872.

"On Datolite." *Tschermak's Mineralogische Mittheilungun*, i. 1874.

"On a Remarkable Crystal of Andalusite." *Am. Journ. Sci.* [3], vol. iv. p. 473.

"On Atacamite." *Tschermak's Mineralogische Mittheilungen*, i., 1874.

"On the Thermo-electrical Properties of some Minerals." *Am. Journ. Sci.* [3]. vol. viii. p. 255.

"On the Trap Rocks of the Connecticut Valley." *Am. Journ. Sci.* [3]. vol. viii. p. 390.

And in company with W. G. Mixter, of the Sheffield Scientific School—

"On the Specific Heat of Zirconium, Silicon, and Boron." *Ann. Chem. u. Pharm.*, vol. clix. p. 388.

Albert R. Leeds, Professor of Chemistry, Stevens Institute of Technology, Hoboken, New Jersey, has contributed as follows:—

1873. Contributions to Mineralogy with analyses of: I. A Hydrous Unisilicate approaching Pyrosclerite. II. Talc Pseudomorphous after Pectotile. III. Leucangite from Amity, N. Y. IV. Mineral associated with Corundum and approaching Ripidotile. V. Moonstone from Media, Delaware County, Pa. VI. Antholite from the "Star Rock," Concord, Delaware Co., Pa. VII. Wernerite from Van Arsdale's Quarry, Bucks Co., Pa. *Am. Journ. Sci.* [3], vi. 22.

Spectroscopic Examination of Silicates. *Am. Chem.*, vol. iii. 446.

Blake Crusher for Laboratory Use. *Ibid.* 453.

On the Volumetric Determination of Chlorine with Standard Silver Solution and Potassic Chromate. *Ibid.* 290.

1874. On the Dissociation of Certain Compounds at very low Temperature. *Am. Journ. Sci.* [3], vii. 197.

On the Purification of Mercury. *Am. Chemist*, vol. iv. 309.

Upon Alizarin as a Test. *Ibid.* 333.

Upon the Alteration of Albite and the Genesis of Deweylite. *Ibid.* 164.

The Student's Practical Chemistry. In connection with Prof. H. Morton. 1865.

Chemical Notes, Reviews, and Experiments. *Jour. Franklin Institute*, 1867–1871.

Gasometer for Accurate Measurements. *Jour. Franklin Institute*, 1868.

Chemical Tables according to the Theories of Modern Chemistry. *Jour. Franklin Institute*, 1870, and *Chemical News*.

Analysis of some hitherto Undetermined Minerals. *Jour. Franklin Institute*, 1870.

On the Spectra of Certain Metallic Compounds, *Jour. Franklin Institute*, 1870, and *Quarterly Journal of Science*.

On Aventurine Orthoclase. *Amer. Jour. Sci.*, 1872.

Ira Remsen, Professor of Chemistry, Williams College, Williamstown, Mass.—Prof. Remsen has contributed the following important papers:—

1870. "Uber die Homologen des Naphtalins." *Liebig's Annalen.*
"Investigations on Piperic Acid" (Dissertation for Degree of Ph.D. at the University of Göttingen).

1871. "Ueber eine neue Darstellungsmethode der Paraoxbenzœsäure." *Zeitschrift für Chemie.*
"Ueber die Constitution der Protocatechusäure." *Ibid.*
"Ueber Parasulfobenzœsäure." *Ibid.*

1872. "Weitere Untersuchungen über die Constitution der Piperinsäure." *Liebig's Annalen.*

1873. "Investigation on Parasulphobenzoic Acid." *Am Journ. Sci.* [3], pp. 179–186; *Ibid.*, 274–282, and 354–362. Prof. Remsen has also published a translation. *Am. Journ. Sci.*

"On Isomeric Sulphosalycylic Acids." *Am. Journ. Sci.*

1874. "On the Formation of Paratoluic Acid from Parasulphotoluenic Acid." *Ibid.*

"On Nitroparasulphobenzoic Acid." *Ibid.*

"On the Action of Potassium upon Ethyl Succinate." *Ibid.*

In 1873 he edited Fittig's Wöhler's "Outlines of Organic Chemistry;" with additions. Prof. Remsen also furnishes abstracts and articles of the *Berichte der deutschen Chem. Gesellschaft* for each number of the *American Chemist.*

W. C. MAY has published ("Chemical Papers from the Massachusetts Institute of Technology, No. 11")—

1873. "On the Determination of Lead as Peroxide." *Ibid.* [3], vi. 255.

H. B. CORNWALL, E.M., Professor of Mineralogy and Chemistry in the John C. Green Scientific School, College of New Jersey, Princeton, has contributed papers—

1873. On the Occurrence of Indium discovered in American Blendes. *Am. Chemist*, January.

A Quantitative Analysis of Roxbury Blende. *Am. Chemist*, October.

We are also indebted to Prof. Cornwall for his excellent translation of—

1872. Plattner's Manual of Qualitative and Quantitative Analysis with the Blowpipe. From the last German Edition, etc. N. Y.: D. Van Nostrand. 8vo. pp. 548. And—

1873. A second edition of the above.

F. M. F. CAZIN, M.E., Denver, Colorado.—Mr. Cazin has published a paper entitled—

1873. Fluor Spar in its application in the Cupola Furnace, and in the Puddling and Bessemer Process. *Berg. und huetten Marnnsch Zeit.*, xxxii. No. 15.

REGIS CHAUVENET and A. A. BLAIR, St. Louis, Mo., have published, in joint authorship—

Chemical Analyses of the Coals, Iron Ores, and Iron of Missouri. 8vo. pp. 1873, N. Y. Extracted from the Report of the Geological Survey of Missouri. 1873.

WILLIAM J. LAND, Atlanta, Georgia.—Mr. Land has published the following contributions in the *American Chemist*, vol. iii.:—

Determination of Hydrosulphuric Acid in Mineral Waters.

Improved Atmospheric Washing Bottle for the Use of Analytical Chemists.

Improved Apparatus for General Gasmetry (with a drawing).

He has also published in Georgia—

Analysis of the Ash of the Cotton Plant, etc.

Analysis of the Ash of the Cotton Seed.

A. P. S. STUART, Professor of Chemistry, Illinois Industrial College, Champaign, Illinois, has published as follows:—

1. In the third and fourth *Reports of the Illinois Industrial University*—

On the Organic Matter of Soils.

On the Origin and the Physical and Chemical Properties of the Inorganic Matter of Soils.

2. In the *Prairie Farmer*—

On the Influence of Light in the Growth of Plants.

3. In the *Transactions of the Illinois State Horticultural Society*—

On the Distribution of Nitrous Acid in Plants.

On the Use of a Glazed Wrought-iron Tube for Nitrogen Determinations.

WM. McMURTRIE, Washington, D. C.—In his capacity of Chemist to the Department of Agriculture, Mr. McMurtrie has contributed a number of interesting researches, the results of which are embraced in the Monthly Reports of that Department for 1873–4. These are chiefly analyses of fertilizers, corn, wines, soils, etc., which are important additions to agricultural knowledge.

CHARLES A. BRINLEY, Midvale Steel Works, near Philadelphia.—Mr. Brinley's paper, "Notes on a Charcoal Furnace" (*Am. Chem.*, iii. No. 1), contains some analyses of iron and furnace products.

E. S. BREIDENBAUGH has published ("Contributions from the Sheffield Laboratory of Yale College, No. 27") a valuable research with numerous analyses—

1873. "On the Minerals found at the Tilly Foster Iron Mines, New York." *Am. Journ. Sci.* [3], vi. 207. This locality proves to be one of the most interesting chapters in American mineralogy, furnishing the material for Prof. Dana's paper, "On Serpentine Pseudomorphs and other Kinds" (Nov. 1874), and a wonderful development of new crystalline forms of Chendrodite now under examination by Mr. Edward S. Dana.

EDWARD W. MORLEY, Professor of Chemistry, Western Reserve College, Hudson, Ohio.—Professor Morley has described—

"An Apparatus for Rapid Filtration." *Am. Jour. Sci.* [3], vi. 214. 1873.

C. W. HINMAN, B.S., Boston, Mass.—Mr. Hinman has just published Description of a new Apparatus for Gas Analysis. *Sill. Journ.* [3], viii. 182. Sept., 1874.

HENRY WURTZ.—A considerable number of the contributions of this chemist we find have been overlooked in the former list (see pp. 109, 110). To some of these he has called our attention, as follows:—

1868. On Some New Chemical Relations of Metallic Aluminum. *Am. Association at Chicago, in* 1868, p. 196.

1869. Studies in Chemical Geogony. Three subjects: 1. On the Prozoic Atmosphere, and the Ocean of the Zoic Dawn. 2. Zoic History, from a Chemical View-Point. 3. Chemical Revelation of a Final Zoic Catastrophe. *Am. Association at Salem*, 1869, pp. 217, 223, 225.

1872. Lithology of the Rocks of the Palisade Range. *Am. Chemist*, Jan. 1872, p. 258.

1872. Some Chemi-Genetic Views regarding the Past and the Future. *Am. Chemist*, April, 1872, p. 385.

1873. Chemical and Sanitary Report upon the Passaic River. *Am. Chemist*, Sept. 1873, p. 99, and Oct. 1873, p. 133.

1874. Second Chemical and Sanitary Report upon the Water Supply of the Cities of Newark and Jersey City. *Am. Chemist*, March, 1 74, p. 323.

1874. Subaerial Oxygenation of Waters. *Proceedings of N. Y. Lyceum of Natural History*, Feb. 18 74.

1874. Discussion of the above Subject with Dr. H. Endemann. *Am. Chemist*, July, 1874, pp. 9, 10.

INDEX TO PROF. SILLIMAN'S ESSAY ON AMERICAN CONTRIBUTIONS TO CHEMISTRY.

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